3.0 Description and Comparison of Alternatives

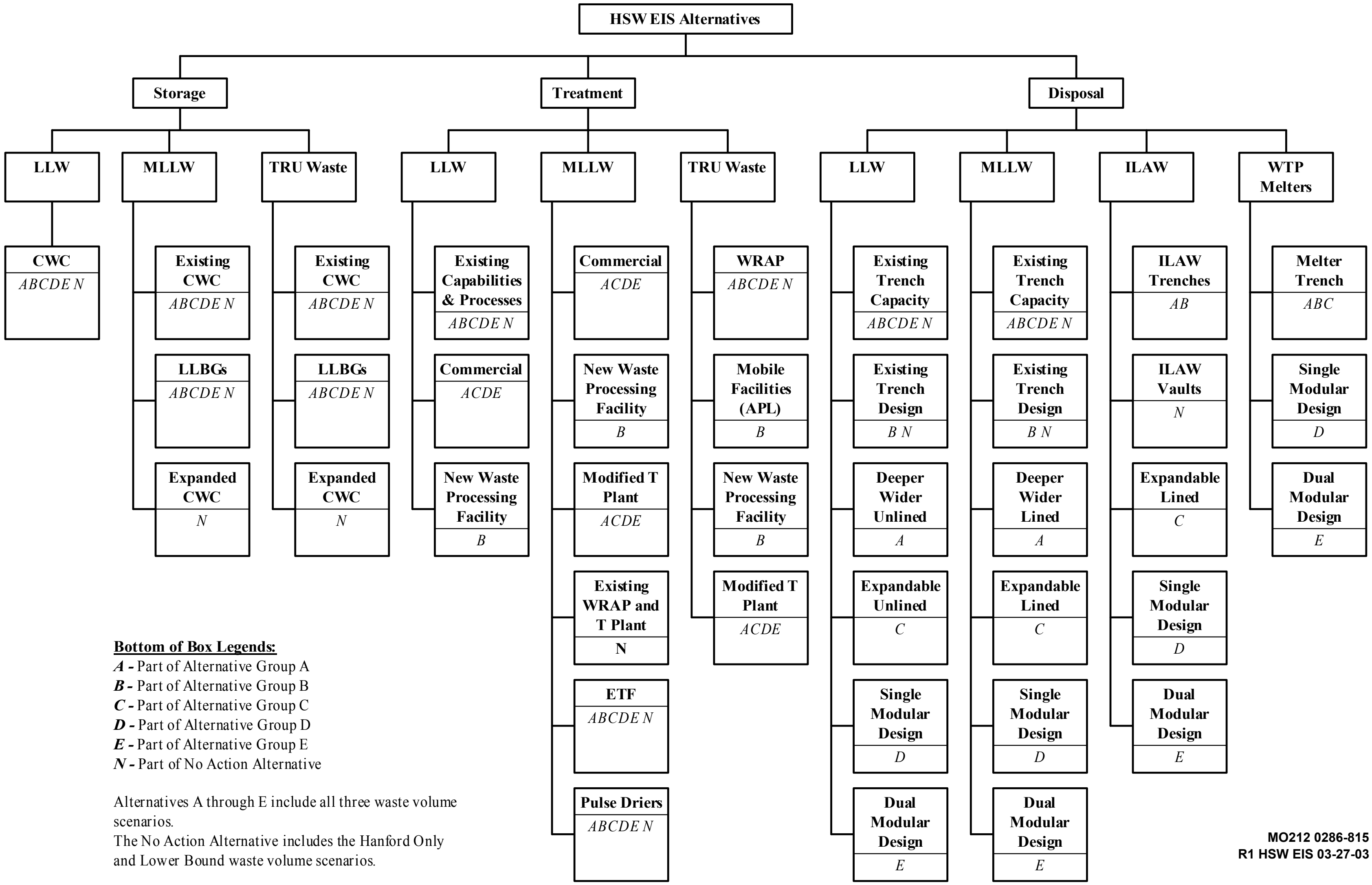
This section describes the alternatives for storage, treatment, and disposal that are analyzed in this revised draft of the Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement (HSW EIS) as well as alternatives eliminated from detailed analysis. As required by the Council on Environmental Quality (CEQ) regulations implementing the National Environmental Policy Act (NEPA) of 1969 (40 CFR 1500-1508), a No Action Alternative is also included.

The waste streams and facilities that are considered in this EIS were identified and described in Sections 2.1 and 2.2. Section 3.1 describes the alternatives and the development and selection of alternative groups that are analyzed in detail. Section 3.2 identifies alternatives that were not analyzed in detail. The three waste volumes, Hanford Only, Lower Bound and Upper Bound are presented as alternative waste volume scenarios in Section 3.3. A comparison of the environmental impacts associated with each of the alternative groups is contained in Section 3.4. The major uncertainties in the EIS analysis are identified in Section 3.5. A summary of the estimated costs for the alternative groups is included in Section 3.6. The U.S. Department of Energy (DOE) preferred alternative is discussed in Section 3.7. Detailed descriptions of alternatives, assumptions, waste volumes, and waste stream flowsheets are provided in Appendixes B and C. The Section 2 and the Technical Information Document (TID) prepared by Fluor Hanford, Inc. (FH 2003) to support this EIS should be reviewed when additional information on a facility or waste stream is desired.

3.1 Alternatives Considered in Detail and Their Development

The CEQ regulations direct all federal agencies to use the NEPA process to identify and assess the reasonable alternatives to proposed actions that would avoid or minimize adverse effects of the proposed action on the quality of the human environment. Related CEQ guidance in 46 FR 18026 (Forty Most Asked Questions) states that "When there are potentially a very large number of alternatives, only a reasonable number of examples, covering the full spectrum of alternatives, must be analyzed and compared in the EIS." In considering the alternatives for this EIS it was quickly recognized that there is a very large number of combinations of the various waste streams, potential waste volumes and individual options for storage, treatment, and disposal. Therefore, the alternatives developed for this EIS were selected to represent the full spectrum of reasonable alternatives.

The individual alternatives for the proposed actions are shown in Figure 3.1. The alternatives are first subdivided into three types of action (storage, treatment, and disposal), then further subdivided into specific alternatives for each of the waste types (LLW, MLLW, TRU waste, ILAW, and melters) as appropriate. It should be noted that no storage or treatment alternatives are shown for ILAW and melters because those activities have been, or are being, evaluated in separate NEPA reviews (DOE and Ecology 1996; 68 FR 1052). Also, no disposal alternatives are shown for TRU waste because DOE previously decided to dispose of TRU waste at the Waste Isolation Pilot Plant (WIPP, DOE 1997a). WIPP alternatives and activities are also not within the scope of this EIS. Disposal alternatives for each of the waste



Bottom of Box Legends:

***A* -** Part of Alternative Group A
***B* -** Part of Alternative Group B
***C* -** Part of Alternative Group C
***D* -** Part of Alternative Group D
***E* -** Part of Alternative Group E
***N* -** Part of No Action Alternative

Alternatives A through E include all three waste volume scenarios.
The No Action Alternative includes the Hanford Only and Lower Bound waste volume scenarios.

Figure 3.1. Options for HSW EIS Alternatives

types consider both independent disposal facilities for a single waste type as well as modular combined-use disposal facilities that would contain either two or four of the waste types.

It should be noted that Figure 3.1 has been simplified by considering actions where possible at the four waste type levels, rather than the 21 waste stream levels (see Figure 2.1 in Section 2). In the descriptions of the alternatives, specific actions for individual waste streams are also discussed. With the primary alternatives in Figure 3.1, alternative groups can be defined from the potential combinations of storage, treatment, and disposal alternatives for each of the waste types. However, these groupings for purposes of analysis are not intended to be restrictive in the final selection and implementation of the EIS alternatives. DOE may ultimately develop its final decisions based on a different combination of specific actions for individual waste streams.

For the analysis of potential actions, DOE has defined six representative alternatives groups from among the many possible combinations. It is necessary in the development of an alternative to specify options for each of the waste types and to include a full set of treatment, storage, and disposal activities. For the purposes of this EIS, each selected set of activities is called an alternative group, since it consists of a group of alternatives for various waste types and activities. The use of groups in the analysis is necessary because some facilities can process more than one waste type, and some impacts are only meaningful when assessed using a complete set of alternatives. The alternative groups have been identified as A, B, C, D, E, and No Action (N). Key characteristics of each of the groups are shown in the adjacent text box. Each of the alternative groups is discussed in greater detail in subsequent sections. The individual alternative actions that are used in each of the alternative groups can be noted by the corresponding letter in italics at the bottom of each box. Note that some individual alternatives are used in all alternative groups, whereas in other cases an alternative is only used in one alternative group. For Alternative Groups D and E, different potential disposal facility locations within the Hanford Central Plateau are under consideration and have been evaluated in Section 5. The specifics for the locations are discussed in their respective sections (3.1.5 and 3.1.6). The locations of the major facilities are shown in Figure 3.2.

Alternative Groups

A – Additional treatment in the modified T Plant and disposal in deeper and wider trenches.
B – Additional treatment in a new waste processing facility and disposal in existing trench designs.
C – Additional treatment in the modified T Plant and disposal in a single expandable trench for each waste type.
D – Additional treatment in the modified T Plant and disposal in a single expandable trench containing LLW, MLLW, and WTP wastes.
E – Additional treatment in the modified T Plant and disposal in two expandable trenches, one with LLW and MLLW, and the second with ILAW and WTP melters.

Within the EIS, DOE analyzes as many as three alternative waste volume scenarios. The “Hanford Only” waste volume represents waste forecast to be received from Hanford Site generators. The “Lower Bound” waste volume is the current best estimate of the amount DOE could receive from offsite (based on past receipts) combined with the best projection of what might be generated at Hanford. The “Upper Bound” waste volume provides the highest projected offsite waste volume that could be received, along with the best projection of what might be generated at Hanford.

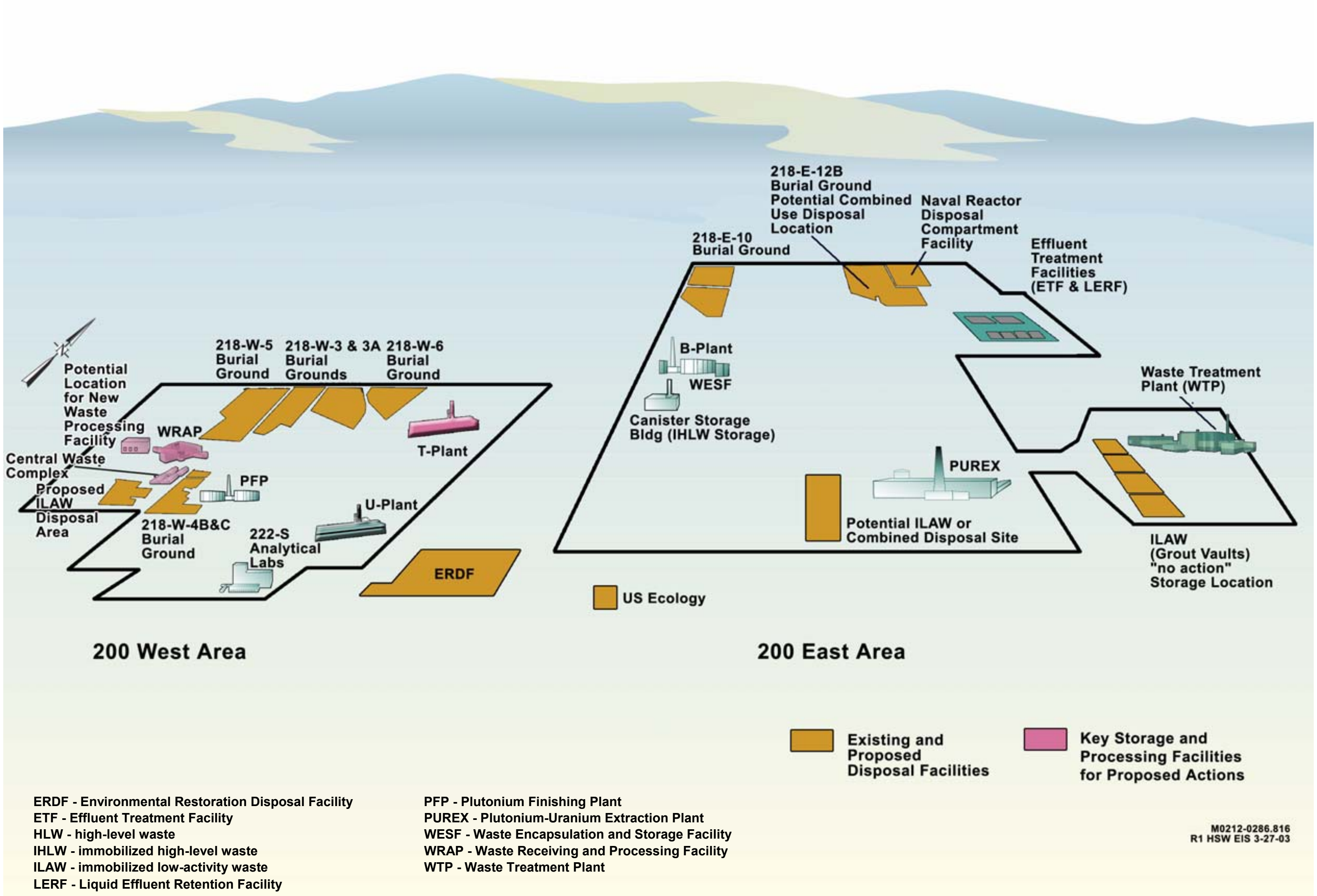


Figure 3.2. Locations of Existing and Potential Processing and Disposal Facilities on the Hanford Site

The Hanford Only waste volume excludes future offsite waste volumes entirely so the incremental impacts of receiving offsite waste could be determined. The three volumes by waste type are illustrated in Figure 3.3.

3.1.1 No Action Alternative

The No Action Alternative provides a baseline for comparison of the impacts from the proposed action and alternatives and is consistent with decisions reached under previous NEPA reviews. No Action thus reflects the current status quo and continued operation of existing facilities without conducting additional activities necessary to meet regulatory obligations. The No Action Alternative would only partially meet DOE's obligations under the Hanford TPA and applicable regulatory requirements. As such it represents an analytical construct to meet NEPA requirements rather than an expression of DOE's intended future actions.

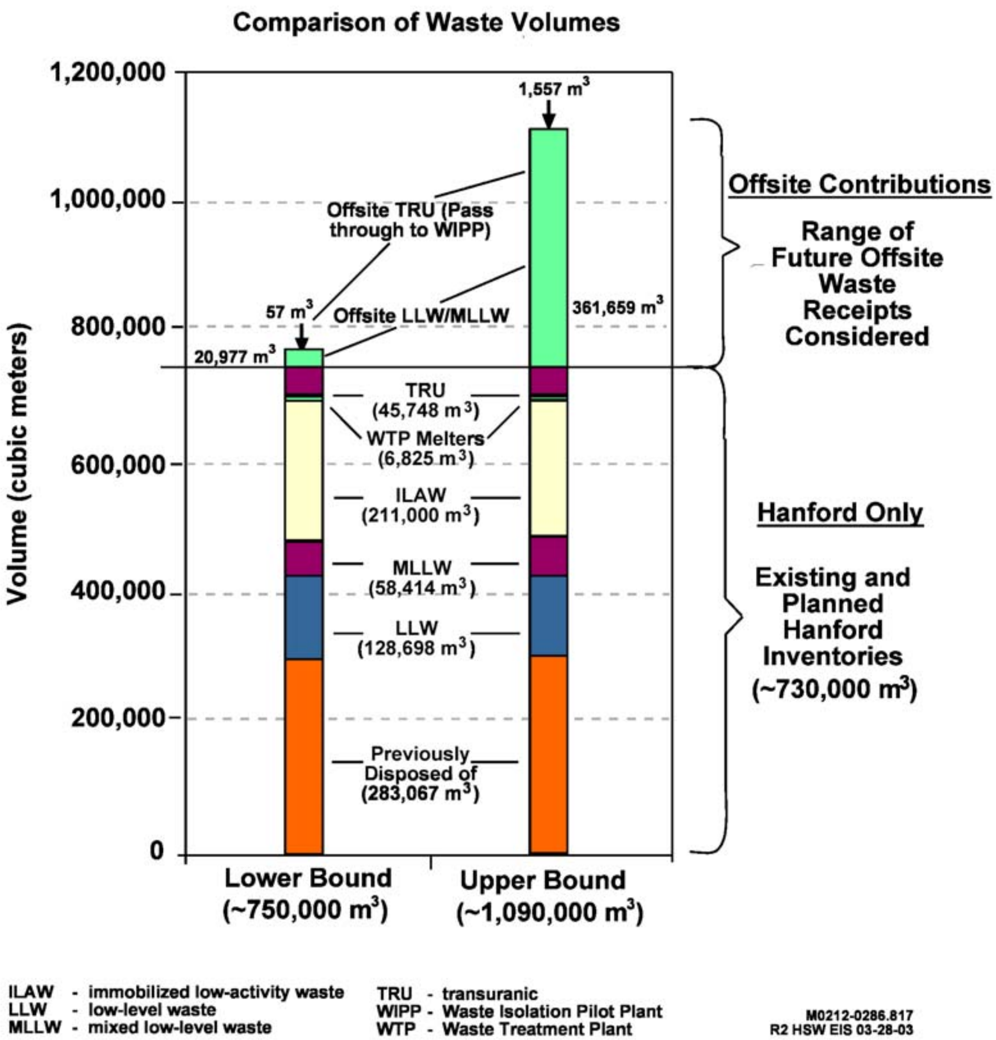


Figure 3.3. Range of Waste Volumes Considered in the HSW EIS

Because most activities considered in the HSW EIS are ongoing operations, or have been the subject of previous decisions made under other NEPA reviews, the No Action Alternative consists of implementing the previous NEPA decisions or of continuing current solid waste management practices, consistent with CEQ guidance. The No Action Alternative for LLW, MLLW, and TRU waste was described in the previous draft HSW EIS (DOE 2002a). The No Action Alternative for disposal of ILAW consists of the preferred alternative selected previously in the Record of Decision (ROD) for the Tank Waste Remediation System (TWRS) EIS (62 FR 8693). The No Action Alternative was evaluated using the Hanford Only waste volume and the Lower Bound waste volume. The ILAW volume reflects a different waste form (cullet in canisters) than that assumed for Alternative Groups A through E (monolithic vitrified waste in canisters).

3.1.1.1 Storage

In the No Action Alternative, additional CWC storage would be needed for waste that could not be treated or disposed of. Hanford's non-conforming LLW would continue to be stored in the CWC. Most MLLW would be stored at CWC due to limited treatment and disposal capacity. Likewise, melters from the WTP would be stored at CWC, as no disposal facility would be available for them. All TRU waste that cannot be processed at WRAP would be stored at CWC or T Plant Complex. The wastes requiring storage would include non-standard containers, RH TRU waste, and PCB-commingled TRU waste. K Basin sludge would remain in storage at the T Plant Complex. Additional storage space would be constructed at CWC as needed for LLW, MLLW, melters, and TRU waste.

The existing grout vaults would be modified for storage of ILAW until disposal vaults were constructed in accordance with the TWRS EIS ROD.

3.1.1.2 Treatment

No treatment capability would be available for non-conforming LLW, and for most MLLW. Treatment of solid MLLW would be limited to the existing commercial treatment contracts and the limited existing capacity of WRAP, the T Plant Complex, and other onsite facilities. Leachate from the MLLW trenches would be collected and sent by truck to the 200 East Area Effluent Treatment Facility (ETF) for treatment. After ETF closes, leachate would be treated using a pulse drier. Solids from that treatment would be sent to the MLLW trenches for disposal or to CWC for storage after the trenches are closed. Previously treated MLLW, potentially including MLLW received from offsite generators, would be directly disposed of in the two existing regulatory-compliant (lined) MLLW trenches as long as space is available.

Processing and certification of TRU waste would continue at WRAP and the T Plant Complex to prepare existing stored and newly generated CH TRU waste packaged in standard containers for shipment to WIPP. The EIS analysis assumed that DOE would continue to operate WRAP until 2032 to perform this function. After closure of WRAP, individual generators would be responsible for certifying and shipping their own waste.

Consistent with the TWRS EIS ROD, ILAW would be processed into cullet (granular glass particles similar to coarse sand), and placed into containers for onsite storage in modified grout vaults that were constructed in the 1980s.

3.1.1.3 Disposal

LLW would be prepared for disposal to meet the *Hanford Site Solid Waste Acceptance Criteria* (HSSWAC, FH 2002). Cat 1 wastes would be placed directly into the LLBGs. Cat 3 and GTC3 wastes would either be disposed of in high-integrity containers (HICs) or in-trench grouted. DOE would continue the practice of building LLW disposal trenches in the LLBGs using the current trench design (unlined) as additional disposal capacity is needed. DOE would backfill the trenches with soil as their capacity is reached, but the trenches would not be capped.

Disposal of MLLW would occur only in the two existing MLLW trenches. The MLLW trenches would be capped in accordance with regulations after they are filled. An additional 66 new vaults would be constructed for ILAW disposal in the 200 East Area within 3.1 km (1.9 mi) of the existing vaults southwest of PUREX. The new vaults would contain a leachate collection system and would have an array of monitoring wells. All ILAW would be transferred to the new vaults, which would be equipped with a crane to place the containers into specific locations that would be recorded into a registry that includes container serial number, date, and position. An interim barrier containing a surface liner and an interim cover of sand and gravel totaling about 3.3 m (11 ft) thick would be placed over the containers. A regulatory-compliant barrier would be applied at closure.

3.1.2 Alternative Group A

Alternative Group A includes actions for management of LLW, MLLW, and TRU waste as described in Alternative 1 of the first draft HSW EIS (DOE 2002a). An alternative for disposal of ILAW has been added to this group. The storage, treatment, and disposal alternatives included in Group A are described in the following sections.

3.1.2.1 Storage

Most LLW would not be stored, but would be sent directly to the LLBGs. However, some waste would be received and placed into temporary storage in CWC until it could go to WRAP for inspection. After passing inspection it would be sent on to the LLBGs. Non-conforming LLW that cannot go to disposal would be stored in CWC until it could be sent to a treatment facility. No long-term storage of LLW is expected in Alternative Group A.

Historically, MLLW has been stored in CWC and would continue to be stored there until treatment is available. In Alternative Group A, all MLLW would be treated, so no long-term storage would be needed.

TRU waste is currently stored in CWC and in the LLBGs. In Alternative Group A, all of the waste would be sent to onsite processing facilities and then to WIPP, thus eliminating any long-term onsite storage requirement.

WTP waste including the ILAW and melters would be sent directly to their respective disposal facilities. Storage of these wastes is not evaluated in this EIS.

3.1.2.2 Treatment

LLW needs to meet the HSSWAC before it can be disposed at Hanford. Most LLW does not require treatment to meet the HSSWAC. Treatment of LLW for volume reduction is not generally economically beneficial and is therefore not proposed as part of the HSW EIS alternatives. Cat 1 wastes would be placed directly into the LLBG following verification. Cat 3 and GTC3 wastes would continue to be either emplaced in HICs or in-trench grouted. For purposes of analysis, it was assumed nonconforming LLW that could not be treated onsite would be treated in a commercial treatment facility and returned to Hanford for disposal.

At Hanford, most MLLW arrives treated and ready for disposal without further treatment. Other waste streams require treatment in accordance with regulatory requirements to allow the wastes to meet the HSSWAC for onsite disposal. Six MLLW streams are evaluated in this HSW EIS, each of which involves specific treatment standards. DOE would continue to use limited existing treatment capabilities at the T Plant Complex and WRAP; however, most MLLW generated at Hanford would require development of new treatment capacity.

Treatment standards for CH Inorganic Solids and Debris specify treatment by macroencapsulation as demonstrated by an existing commercial contract. DOE would continue to use commercial facilities to treat most of Hanford's CH MLLW, with minimal onsite treatment in the modified T Plant Complex. CH Organic Solids and Debris require thermal treatment if such capability is available. Availability of thermal treatment technologies has been limited; however, in this Alternative Group it is assumed that the commercial facilities would become available to treat these wastes. Most Elemental Lead, which would likely be treated by macroencapsulation, and Elemental Mercury wastes, possibly treated by thermal desorption, would be sent to commercial treatment facilities. The Mixed Waste Trench Leachate would be treated in ETF, and pulse driers would be used after ETF closes. Treatment would be the same as in the No Action Alternative; however, the volume would be much higher with additional disposal trenches.

The RH and non-standard Packages of MLLW and TRU waste require new treatment and processing capabilities. In Alternative Group A, operations such as size-reduction and repackaging technologies and RH macroencapsulation capacity would be incorporated into the Modified T Plant to process these waste streams.

In Alternative Group A, the CH TRU wastes from trenches, wastes currently stored in CWC, and newly generated TRU wastes in standard packages would be processed in WRAP. DOE would continue to operate WRAP until 2032 to perform this function. After closure of WRAP, individual Hanford generators would be responsible for certifying and shipping their own waste. The RH and non-standard wastes from trenches and caissons, wastes currently stored in CWC, newly generated wastes, polychlorinated biphenyl (PCB) wastes, and K Basin sludge, would be processed in a modified T Plant using a variety of technologies to package and certify the wastes for WIPP.

3.1.2.3 Disposal

Alternative Group A would utilize the existing LLW trenches in the LLBG until they have been filled, and then additional disposal trenches would be constructed in the 200 West Area using a deeper, wider trench design to increase the efficiency of the disposal operations and to maintain the current focus of LLW disposal operations in the 200 West Area in accordance with the previous performance assessments for LLW disposal. Unlined deeper wider trenches would be used after about 2005.

MLLW disposal alternatives would use the existing MLLW trenches until they have been filled and then develop deeper, wider lined trenches in the 200 East Area. Leachate from the 200 East Area disposal facilities would then be sent by truck to the ETF for treatment, and pulse driers would be used thereafter.

TRU waste would be shipped to WIPP.

The ILAW canisters would be placed into a dedicated disposal facility near PUREX in multiple lined trenches.

The large WTP melters would be taken to a dedicated lined trench near PUREX for disposal.

All of the MLLW trenches would be capped when the trenches are filled. Other LLW trenches, ILAW, and melter trenches would be closed at the end of their mission and the disposal facilities would be capped in accordance with applicable regulatory requirements with the modified RCRA Subtitle C barrier.

3.1.3 Alternative Group B

Alternative Group B includes activities that maximize onsite treatment of MLLW and non-conforming LLW, and which involve construction of new facilities to treat LLW, MLLW, and TRU waste. Disposal of LLW and MLLW would take place in less efficient trench configurations of existing design. Disposal of WTP melters and ILAW would use the same trench configurations as in Alternative Group A, but would occur in different locations. This combination of alternatives is expected to result in the maximum short- and long-term environmental impacts because it includes more onsite activities and new construction. Alternatives included in Alternative Group B are described as follows.

3.1.3.1 Storage

The storage alternatives for LLW, MLLW, and TRU waste are the same in Alternative Group B as in Alternative Group A.

3.1.3.2 Treatment

LLW treatment alternatives are the same as in Group A, except for the non-conforming wastes. Those wastes would be sent to an onsite New Waste Processing Facility rather than to a commercial treatment facility.

MLLW treatment would first complete the existing commercial contracts and then utilize the New Waste Processing Facility rather than using additional offsite commercial facility contracts and the modified T Plant as in Alternative Group A.

TRU waste would be prepared for shipment to WIPP. The New Waste Processing Facility would be used for RH and non-standard wastes, and other wastes that would go to the modified T Plant as in Alternative Group A. WRAP would continue operations as the main processing facility for CH TRU wastes, and TRU waste processing capacity would be increased by the use of mobile treatment capabilities.

3.1.3.3 Disposal

As in Alternative A, the existing LLW trenches and existing MLLW trenches would first be utilized. Then additional facilities based on the current design for LLW trenches would be built in the 200 West Area. Additional MLLW trenches of the current design would be built in the 200 East Area. Leachate from the 200 East Area disposal facilities would then be sent by truck to the ETF for treatment, and pulse driers would be used thereafter.

The WTP melters would be disposed of in a single expandable lined trench to be built in the 200 East Area LLBGs, and the ILAW would be disposed of in multiple lined trenches to be built in the 200 West Area.

All of the mixed waste trenches would be capped with a modified RCRA Subtitle C barrier in accordance with applicable regulatory requirements. The rest of the LLBGs would be capped at closure.

As in Alternative Group A, CH TRU waste in standard containers would be processed at WRAP. The New Waste Processing Facility would be used to process and certify RH and non-standard containers of TRU waste. All of the processed and certified TRU waste would be shipped to WIPP.

3.1.4 Alternative Group C

Alternative Group C activities for storage, treatment, and processing of LLW, MLLW, and TRU waste are the same as those considered in Alternative Group A. This group also includes use of existing LLW and MLLW disposal capacity before construction of new disposal facilities and appropriate closure as in Alternative Group A.

Additional disposal alternatives in Alternative Group C include: LLW disposal in the LLBGs in a single expandable unlined trench in the 200 West Area; MLLW disposal in the LLBGs in a single expandable lined trench in the 200 East Area; ILAW disposal in a single expandable lined trench near PUREX, and melter disposal in a single expandable lined trench also near PUREX. All of the trenches would be capped with a modified RCRA Subtitle C barrier at closure in accordance with applicable regulatory requirements.

3.1.5 Alternative Group D

Alternatives for treatment and processing of LLW, MLLW, and TRU waste are the same as those considered in Alternative Group A. Alternative Group D considers a single lined modular combined-use facility for onsite disposal of all LLW, MLLW, ILAW, and WTP melters. This Alternative Group contains three subalternatives that correspond to different locations for the combined-use disposal facility. The subalternatives are denoted by subscripts. This group also includes use of existing LLW and MLLW disposal capacity before construction of new disposal facilities and appropriate closure as in Alternative Group A. The three subalternative locations for the single combined-use disposal facility are:

- Alternative Group D_1 – 200 East Area near the PUREX plant
- Alternative Group D_2 – 200 East Area LLBGs
- Alternative Group D_3 – at ERDF.

During final design a combined-use disposal facility could be configured in numerous ways. Different waste types could be disposed of in separate cells within a combined-use disposal facility, or different waste types could be disposed of in the same cell (commingled). Little interaction between the different waste types is anticipated because MLLW, ILAW, and the melters would be treated to meet applicable regulatory requirements. In addition, all waste types would need to meet the waste acceptance criteria for that disposal facility. The separate cells could be permitted under RCRA where appropriate, or the entire facility could be operated under a single regulatory program.

3.1.6 Alternative Group E

Alternatives for treatment and processing of LLW, MLLW, and TRU waste are the same as those considered in Alternative Group A. This group also includes use of existing LLW and MLLW disposal capacity before construction of new disposal facilities and appropriate closure caps as in Alternative Group A. Alternative Group E considers two onsite lined combined-use facilities, one facility for combined disposal of LLW and MLLW, and a separate facility for combined disposal of ILAW and WTP melters. Alternative Group E contains three subalternatives that correspond to different combinations of locations for the two disposal facilities. The subalternatives are denoted by subscripts. This group also includes use of existing LLW and MLLW disposal capacity before construction of new disposal facilities and appropriate closure as in Alternative Group A. The subalternative locations for the two dual use disposal facilities are:

- Alternative Group E_1 – combined disposal of LLW and MLLW in a modular lined facility in the 200 East Area LLBGs; combined disposal of WTP melters and ILAW in a modular lined facility at ERDF;

- Alternative Group E_2 – combined disposal of LLW and MLLW in a modular lined facility near PUREX; combined disposal of WTP melters and ILAW in a modular lined facility at ERDF; and

- Alternative Group E_3 – combined disposal of LLW and MLLW in a modular lined facility at ERDF; combined disposal of WTP melters and ILAW in a modular lined facility near PUREX.

During final design a combined-use disposal facility could be configured in numerous ways. Different waste types could be disposed of in separate cells within a combined-use disposal facility, or different waste types could be disposed of in the same cell (commingled). Little interaction between the different waste types is anticipated because MLLW, ILAW, and the melters would be treated to meet applicable regulatory requirements. In addition, all waste types would need to meet the waste acceptance criteria for that disposal facility. The separate cells could be permitted under RCRA where appropriate, or the entire facility could be operated under a single regulatory program.

3.1.7 Summary Tables of Alternative Groups

To facilitate comparison and references for each of the alternative groups, Tables 3.1 and 3.2 summarize the various actions proposed as part of each group. Table 3.1 provides the treatment alternatives and Table 3.2 provides the disposal alternatives. Table 3.1 identifies the various treatment alternatives on a waste stream level and shows which individual alternatives (indicated by bullet) are included in each alternative group. The ILAW and melter waste types are not included in Table 3.1 since the treatment of ILAW and melters is part of the WTP scope. In Table 3.2 the individual disposal facility alternatives are shown for each alternative group.

3.2 Alternatives Considered but Not Evaluated in Detail

This section describes alternatives that were considered as possible methods for the management of one or more of the waste types, but were not evaluated in detail, because DOE has determined that they are not currently reasonable alternatives. The alternatives are organized by the key activity of storage, treatment, and disposal. This section also provides a qualitative discussion of the Stop Work scenario.

3.2.1 Storage Options

3.2.1.1 Storage of Waste at the Generators' Sites

Storage of waste at either the Hanford or offsite generators' sites could potentially reduce the storage requirements at CWC. However, the action alternatives do not require additional storage beyond the current CWC capacity. Storage at multiple sites would not allow DOE to take advantage of the economies of scale possible by consolidation of the wastes at CWC and would make security more difficult. Continued storage at generator's sites could be inconsistent with LDR requirements and site treatment plans. Most onsite and offsite generators do not have permitted available onsite storage and would need to increase storage capacity and might adversely impact cleanup and closure activities.

3.2.1.2 Shipment of Hanford GTC3 Wastes to Other Sites for Longer-Term Storage

No GTC3 LLW is forecast to be generated at Hanford, but 1 m^3 is assumed for analysis to address future contingencies. The amount of storage required for this waste is so small in comparison with other wastes, that storage of this waste at Hanford is not expected to impact the required capacity at CWC in any of the alternatives. Shipment of GTC3 wastes from Hanford to other DOE sites would not be

Table 3.1. Treatment Alternatives Summary

Treatment Alternatives	Alternative Groups for Analysis					
	A	B	C	D	E	No Action
LLW – Cat 1						
None required; optional by generator	-	-	-	-	-	-
LLW – Cat 3, GTC3						
HICs or Trench Grouted	s	s	s	s	s	s
LLW – Non-Conforming						
Offsite Facility, establish new contract(s)	•		•	•	•	
New Waste Processing Facility in 200 W Area		•				
None (storage of untreated LLW)						•
MLLW – RH & Non-Standard Containers						
Modified T Plant	•		•	•	•	
New Waste Processing Facility in 200 W Area		•				
None (storage of untreated MLLW)						•
MLLW – CH Standard, Organic Solids & Debris						
Offsite Facility, complete existing commercial contract	s	s	s	s	s	s
Offsite Facility, establish new contract(s)	•		•	•	•	
New Waste Processing Facility in 200 W Area		•				
None (storage of untreated MLLW)						•
MLLW – CH Standard, Elemental Lead, Elemental Mercury						
Offsite Facility	•		•	•	•	
New Waste Processing Facility in 200 W Area		•				
None (storage of untreated MLLW)						•
MLLW – Disposal Trench Leachate						
Effluent Treatment Facility (ETF)	s	s	s	s	s	s
Pulse dryers after ETF closure	s	s	s	s	s	s
TRUW – CH Standard (retrievably stored in LLBGs & CWC, newly generated)						
WRAP	•	•	•	•	•	•
Mobile Units in 200 W Area		•				
TRUW – CH Non-Standard (LLBGs, CWC, newly generated), RH (LLBGs, caissons, CWC, newly generated), K Basin sludge, PCB Commingled						
Modified T Plant	•		•	•	•	
New Waste Processing Facility in 200 W Area		•				
Mobile Units in 200 W Area		•				
None (storage of unprocessed TRU Waste)						•

- = Activity not included in analysis
s = Activity included in analysis; same for all alternatives
• = Alternative actions evaluated in analysis group.

Table 3.2. Disposal Alternatives Summary

Disposal Alternatives for New Construction[(a)]	Alternative Groups for Analysis									
				D			E			
	A	B	C	1	2	3	1	2	3	No Action
LLW – Cat 1, Cat 3, GTC3, Non-Conforming										
200 W LLBG – Existing design unlined trenches		•								
200 W LLBG – Deeper, wider unlined trenches	•									
200 W LLBG – Single unlined trench			•							
Near PUREX – Modular combined-use lined facility				•				•		
200 E LLBG – Modular combined-use lined facility					•		•			
ERDF – Modular combined use lined facility						•			•	
200 W LLBG – Existing design unlined trenches, backfill only, no barrier (Cat 1, Cat 3, GTC3 LLW)										•
None (storage of non-conforming LLW)										•
Previously Buried Waste										
Install modified RCRA Subtitle C barrier	•	•	•	•	•	•	•	•	•	
Backfill only, no RCRA barrier										•
MLLW – treated, ready for disposal, RH & CH MLLW, Elemental Lead & Elemental Mercury, solids from MLLW leachate treatment										
200 E LLBG – Existing design lined trenches		•								
200 E LLBG – Deeper, wider lined trenches	•									
200 E LLBG – Single expandable lined trench			•							
Near PUREX – Modular combined-use lined facility				•				•		
200 E LLBG – Modular combined-use lined facility					•		•			
ERDF – Modular combined-use lined facility						•			•	
None (storage of untreated MLLW and treated MLLW in excess of existing disposal capacity)										•
TRUW – CH Standard										
Ship to Waste Isolation Pilot Plant	s	s	s	s			s			s
TRUW – CH Non-Standard, RH, K Basin sludge, PCB										
Ship to Waste Isolation Pilot Plant	•	•	•	•			•			
None (storage of unprocessed TRUW)										•

(a) In all cases, existing trench space for LLW and MLLW in the 200 W Area, LLBGs would be filled before constructing new disposal capacity. All disposal facilities would be covered with a modified RCRA Subtitle C barrier as filled or at closure, except as noted.

S = Activity included in analysis; same in all alternative groups.

• = Alternative actions evaluated in analysis group.

Table 3.2. (contd)

Disposal Alternatives for New Construction[a]	Alternative Groups for Analysis									
	A	B	C	D			E			No Action
				1	2	3	1	2	3	
WTP Melters										
Near PUREX – Single lined trench	•		•							
200 E LLBG – Single lined trench		•								
Near PUREX – Modular combined-use lined facility				•					•	
200 E LLBG – Modular combined-use lined facility					•					
ERDF – Modular combined-use lined facility						•	•	•		
None (storage)										•
ILAW										
Near PUREX – Multiple lined trenches	•									
200 W Area – Multiple lined trenches		•								
Near PUREX – Single lined trench			•							
Near PUREX – Modular combined-use lined facility				•					•	
200 E LLBG – Modular combined-use lined facility					•					
ERDF – Modular combined-use lined facility						•	•	•		
Near PUREX – Lined vault disposal facility										•

(a) In all cases, existing trench space for LLW and MLLW in the 200 W Area, LLBGs would be filled before constructing new disposal capacity. All disposal facilities would be covered with a modified RCRA Subtitle C barrier as filled or at closure, except as noted.

• = Alternative actions evaluated in analysis group.

consistent with the WM PEIS ROD (65 FR 10061) for LLW and MLLW. The effort required to send waste to another site would be greater than the effort to store onsite. Thus, the most reasonable storage alternative for GTC3 LLW is storage in CWC.

3.2.2 Treatment Options

3.2.2.1 Use of Offsite DOE Facilities for Treatment of All Hanford Waste

The consolidation of waste management functions at designated DOE sites was a major focus of the WM PEIS (DOE 1997b). Attempts were made to identify treatment capacity at other DOE sites for Hanford wastes, but treatment capacity is limited at other DOE sites. Therefore, this is not a reasonable alternative for all Hanford waste. If DOE were able to ship wastes to other DOE sites for treatment, potential impacts would be similar to those for commercial treatment. Hanford may ship small-volume waste streams to other DOE sites in the future if specialized facilities become available. However, impacts of those shipments would be similar to those included for offsite treatment of MLLW.

3.2.2.2 Use of the Effluent Treatment Facility for Non-Conforming LLW

Much of the non-conforming LLW stream is organic-based liquid. The treatment of these liquids in the ETF was considered. However, organic-based liquids wastes are not compatible with the aqueous-based ETF treatment system.

3.2.3 Disposal Options

3.2.3.1 Use of Canyon Facilities for Disposal of Specific Wastes

An ongoing CERCLA study is considering the use of the major canyon facilities for disposal of some waste types that are included in the HSW EIS (Hanford Advisory Board 1997; Richland Environmental Restoration Project 2001). As currently envisioned, higher-hazard waste such as Cat 3 LLW would be placed inside the canyons and lower-activity wastes (Cat 1 LLW, for example) would be placed above and outside the canyon. Waste in the cells might be grouted in place, which would provide additional protection from intrusion as well as mitigating contaminant transport. The entire facility would then be capped with an engineered barrier. Performance monitoring of the barrier would be conducted and adjustments made as necessary. The canyons, with their thick cement walls, would provide containment of the wastes inside and retard their dispersal over the long term. The wastes outside the canyons should be as well contained as wastes placed in the LLBGs. This concept is not sufficiently well developed for detailed analysis at this time. It is being studied as part of the CERCLA process, and if pursued, would be subject to future environmental review before implementation.

3.2.3.2 Leave Retrievably Stored Transuranic Waste in the Low Level Burial Grounds

In this alternative, retrievably stored TRU waste in trenches and caissons would remain buried and would not be retrieved. Further actions could be taken to minimize environmental impacts, including the placement of a barrier over the waste to reduce the potential for further waste migration. This alternative would be attractive from an operational standpoint because it would reduce worker exposure to radio-active materials from retrieval, treatment, and transportation activities, particularly the high radiation doses from RH TRU wastes in the caissons. Modeling of this alternative indicates that it would not result in substantial radionuclide discharges to the accessible environment, or have other major environmental impacts; however, it would not be consistent with previous NEPA decisions to retrieve the waste or with the national policy to ship TRU waste to WIPP.

3.2.3.3 Use of U.S. Ecology Disposal Facility

The U.S. Ecology commercial LLW disposal site is located on land leased to the State of Washington near the 200 Areas within the Hanford Site boundary and could receive some of the LLW expected to be buried in Hanford Solid Waste disposal facilities. A draft State of Washington Environmental Policy Act (SEPA) EIS for the U.S. Ecology facility has been issued (WDOH and Ecology 2000). However, this alternative was not considered reasonable as a replacement for DOE disposal capabilities because some wastes managed by DOE could not be accepted by commercial facilities, and the Hanford infrastructure would still be necessary to manage those wastes. Disposal of DOE waste in commercial facilities would also reduce the limited capacity available for commercial waste disposal. This alternative would offer no clear environmental benefit. LLW would be disposed of on the Central Plateau in unlined trenches, and costs for disposal would be higher.

3.2.3.4 Disposal of All Hanford LLW or MLLW at Other Sites

DOE previously decided that Hanford LLW and MLLW would be disposed of at Hanford (65 FR 10061). Adequate commercial disposal capacity is not available. In view of the large volumes of waste at Hanford, the cost and number of shipments involved with shipping these wastes offsite, and the limited availability of offsite disposal capacity for certain waste types, DOE does not regard shipping the bulk of Hanford waste to other sites for disposal as a reasonable alternative.

3.2.4 Stop Work Scenario

In response to stakeholder comments DOE has included a Hanford Only scenario for waste volumes and included a qualitative discussion of a Stop Work scenario for purposes of comparison with the No Action Alternative as described in the previous section. In the Stop Work scenario, all waste management operations including storage, treatment, and disposal would be terminated. No more waste would be processed or treated and no waste would be disposed of. This scenario would not be in conformance to DOE agreements in the TPA, applicable regulations, or previous NEPA decisions. DOE does not consider this to be a reasonable scenario. Specific actions to be taken for each waste type are noted below and then onsite and offsite impacts are briefly identified. A variation of the Stop Work scenario in which Hanford would cease disposing of LLW and MLLW onsite, but would otherwise maintain normal waste management operations, is discussed further in Appendix O.

Under the Stop Work scenario receipt of LLW would be terminated. Hanford wastes would be stored by the generator, and no offsite wastes would be received. When generators run out of storage space their activities would have to stop also, or other disposal capacity would need to be identified and utilized. No further action would be taken to dispose of waste or to cap the burial grounds. Thus, wastes in the uncapped burial grounds would be exposed to increased water percolation and release to the groundwater.

Under the Stop Work scenario no further MLLW would be received from onsite or offsite generators. Waste would be left in storage, and no treatment of existing or future-generated wastes would occur. No disposal of additional wastes would take place and there would be no closure of the existing MLLW disposal trenches.

Under the Stop Work scenario no further TRU waste would be received from onsite or offsite activities. Generators, such as the Plutonium Finishing Plant, would be required to store waste and ultimately cease operations. There would be no retrieval of suspect TRU waste from the burial grounds. There would be no processing or certification of wastes in WRAP or other facilities, and the wastes would be stored. Waste shipments to the WIPP would cease.

In this scenario for the WTP, DOE would not have the ability to dispose of the ILAW at the Hanford Site. Because of limited storage space for ILAW, tank waste retrieval and operations at the WTP would be jeopardized.

Waste generators (onsite or offsite) would not be able to dispose of waste at Hanford and would have to make other arrangements. The majority of the wastes would require storage at the generator sites. However, storage at multiple sites would not allow DOE to take advantage of the economies of scale possible by consolidating waste management activities. Lastly, most generators are not permitted to store MLLW longer than 90 days. Most onsite and offsite generators do not have onsite storage available, and the need to increase storage capacity could impact cleanup and closure activities and increase environmental impacts at Hanford and other DOE sites.

3.3 Volumes of Waste Considered in Each Alternative

The environmental impacts of the alternatives considered in this EIS will depend in part on the volumes of each waste type managed at the Hanford Site. In order to assess the impacts of different amounts of waste, alternative waste volume scenarios have been analyzed: Hanford Only, Lower Bound, and Upper Bound.

- The **Hanford Only** waste volume consists of 1) the forecast volumes of LLW, MLLW, and TRU waste from Hanford Site generators, 2) the forecast ILAW and melter volumes from treatment of Hanford tank waste, and 3) existing onsite inventories of waste that are already in storage. The analysis also includes waste that has previously been disposed of.

- The **Lower Bound** waste volume consists of 1) the Hanford Only volume, and 2) additional volumes of LLW and MLLW that are currently forecast for shipment to Hanford from offsite facilities. The Lower Bound volume for TRU waste is not substantially greater than the Hanford Only volume, and is not analyzed separately in all cases.

- The **Upper Bound** waste volume consists of 1) the Lower Bound volume, and 2) estimates of additional LLW, MLLW, and TRU waste volumes that may be received from offsite generators as a result of the WM PEIS decisions.

A comparison of the waste volumes used for the HSW EIS analyses is shown in Figure 3.3.

The summary volumes used for each waste type are presented in the following sections. Annual volumes corresponding to the total volumes shown in the tables in this section are listed in Section B.4 of Appendix B (Volume II). These volumes represent the "as-received" volume of waste. As the wastes are treated and prepared for disposal their volumes may change. The changes in volume can be noted in the processing assumptions in Section B.4 of Appendix B (Volume II) and in the flowsheets in Section B.6. A more detailed description of the development of the waste volumes for each type of waste is included in Appendix C (Volume II). The number of significant figures shown in the volume tables can exceed the accuracy of the forecasts but are maintained in the document for consistency of calculations. The radiological and chemical profiles for these waste volumes are in Section B.5 of Appendix B and Appendix F (Volume II), respectively.

3.3.1 LLW Volumes

The alternatives for management of LLW have been analyzed using all three sets of volumes. Table 3.3 shows the volumes of each LLW stream included in each data set. The total LLW in the Hanford Only waste volume is 411,000 m^3. The Lower Bound and Upper Bound waste volumes represent increases of approximately 21,000 m^3 and 220,000 m^3, respectively, compared with the Hanford Only waste volume. The only additional LLW expected to be managed in the Lower Bound and Upper Bound cases are LLW Cat 1 and Cat 3.

Table 3.3. Estimated Volumes of LLW Waste Streams

Waste Streams	Hanford Only (cubic meters)[a]	Lower Bound (cubic meters)[a]	Upper Bound (cubic meters)[a]
Cat 1	88,792	107,883	287,130
Cat 3	39,607	41,334	60,933
GTC3	<1	<1	<1
Non-conforming	299	299	299
Previously disposed waste in LLBG	283,067	283,067	283,067
Total[b]	411,765	432,584	631,429

(a) To convert to cubic feet, multiply by 35.3.
(b) Totals may not equal the sum of the waste stream volumes due to rounding.

3.3.2 MLLW Volumes

As with LLW, the alternatives for management of MLLW have been analyzed using all three sets of waste volumes. The MLLW stream volumes included in each data set are shown in Table 3.4. Slightly over 58,400 m^3 is expected to be managed in the Hanford Only case. Only a small amount of additional waste, approximately 100 m^3, is expected to be managed in the Lower Bound case. The additional volume of waste that would be managed under the Upper Bound case is approximately 140,000 m^3. It is assumed in this EIS that the additional MLLW received in the Upper Bound case would be treated prior to receipt at Hanford and that the waste would be disposed of directly. Therefore, this additional MLLW is included in the Treated and Ready for Disposal waste stream.

3.3.3 TRU Waste Volumes

The three sets of volumes developed for TRU waste are presented in Table 3.5. The Hanford Only waste volume is approximately 45,700 m^3. The Lower Bound waste volume is only slightly larger (by approximately 57 m^3). In the Upper Bound case, an additional 1,500 m^3 of TRU waste would be received

Table 3.4. Estimated Volumes of MLLW Waste Streams

Waste Streams[a]	Hanford Only (cubic meters)[b]	Lower Bound (cubic meters)[b]	Upper Bound (cubic meters)[b]
Treated and Ready for Disposal	28,054	28,082	168,419
RH and Non-Standard Packages	2904	2904	2904
CH Inorganic Solids and Debris	20,108	20,111	20,111
CH Organic Solids and Debris	6727	6790	6790
Elemental Lead	600	608	608
Elemental Mercury	21	21	21
Total[c]	58,414	58,515	198,852

(a) Leachate from MLLW trenches has not been included in this table because the volumes are dependent upon the selected alternative. The total volume of leachate from the MLLW trenches by alternative can be found in the flowcharts in Appendix B.
(b) To convert to cubic feet, multiply by 35.3.
(c) Totals may not equal the sum of the waste stream volumes due to rounding.

Table 3.5. Estimated Volumes of TRU Waste Streams

Waste Streams	Hanford Only (cubic meters)[a]	Lower Bound (cubic meters)[a]	Upper Bound (cubic meters)[a]
Waste from trenches	14,552	14,552	14,552
Waste from caissons	23	23	23
Commingled PCB waste	80	95	95
Newly generated and existing CH standard containers	27,719	27,727	28,897
Newly generated and existing CH non-standard containers	1077	1077	1357
Newly generated and existing RH	2157	2191	2241
K Basin sludge	139	139	139
Total TRU waste[b]	45,748	45,805	47,305

(a) Convert to cubic feet, multiply by 35.3.
(b) Totals may not equal the sum of the waste stream volumes due to rounding.

for temporary storage and eventual shipment to WIPP. Because the differences between the three sets of volumes are small, environmental impacts have been evaluated for the Hanford Only and Upper Bound cases only.

3.3.4 Waste Treatment Plant Waste Volumes

Waste volumes expected from the Waste Treatment Plant are shown in Table 3.6. Because these wastes would be generated at Hanford, the Lower Bound and Upper Bound cases are not applicable. The

Table 3.6. Estimated Volumes of WTP Waste Streams Through 2046

Waste Streams	No Action (cubic meters)[a]	Action Alternatives (cubic meters)[a]
ILAW	350,000	211,000
WTP Melters	6,825	6,825
Total WTP waste	356,825	217,825
(a) To convert to cubic feet, multiply by 35.3.		

volume of ILAW generated by the WTP, however, may vary depending on the waste form produced. For the No Action Alternative, ILAW would be produced in a cullet form and packaged in containers for retrievable disposal in vaults as outlined in the TWRS EIS for the preferred alternative (Phased Implementation). The EIS analysis assumed 140,000 containers would be required, or an equivalent volume of approximately 350,000 m^3. For the action alternatives, ILAW was assumed to be in a monolithic form, packaged in 2.6-m^3 containers for disposal in trenches. Approximately 81,000 containers would be required, or an equivalent volume of approximately 211,000 m^3 (Burbank 2002).

3.4 Comparison of Environmental Impacts Among the Alternatives

For purposes of comparison of impacts among the alternatives in this section, impacts associated with alternative treatment, storage, and disposal actions for each waste type have been combined to provide a consolidated analysis of HSW management operations. These consolidated analyses are referred to as alternative groups, which were described in Section 3.1. The No Action Alternative analysis consists of the No Action activities for each waste type. This approach facilitates comparative presentation of impacts for all Solid Waste Program operations evaluated in this EIS and is necessary where analyses are performed for facilities that are used to manage more than one type of waste. In the alternative group analyses, each of the waste types and activities necessary to manage those wastes are considered. In addition, within the analyses for each alternative group, three alternative waste volume scenarios were considered as described in Section 3.2, namely the Hanford Only, Lower Bound, and Upper Bound waste volumes.

Summary comparisons of impacts among the alternative groups during the operational period and during the long term (10,000 years) after disposal facility closure are presented in Tables 3.7 and 3.8, respectively. The environmental consequences presented in this section represent the incremental impacts from implementing the alternatives for solid waste management described in Section 3.1. The cumulative impacts described in Section 3.4.12 present the proposed action and alternatives in the context of other past, present, and reasonably foreseeable activities to which the waste management operations discussed in this EIS might contribute.

Potential environmental impacts resulting from implementing any of the alternatives are compared in somewhat more detail in the sections that follow. Further details and the supporting analyses for the material presented in this section are provided in Section 5 and its appendixes.

Table 3.7. Summary Comparison of Impacts Among the Alternatives During Operational Period (Present to 2046)

Hanford Only to Upper Bound Waste Volume - Alternative Groups A-E[(a)]															
Hanford Only and Lower Bound Waste Volume for No Action Alternative[(b)]															
	Facility Operations – Direct Radiation and Emissions to Atmosphere						Transportation [(d)]								
	Normal Operations				Fatalities from Operational Accident Having Largest Consequences: Beyond-Design- Basis Earthquake at CWC[(c)]		Routine	# Accidents/# Fatalities from Trauma							
	Chances of Latent Cancer Fatality: Lifetime Exposure of Maximally Exposed Individual														
Alternative	**Public**	**Non-Involved Workers**	**Latent Cancer Fatalities (LCFs) Among Population within 80 km Lifetime Exposure**	**Latent Cancer Fatalities (LCFs) from Collective Radiation Exposure of Workers**	**Public**	**Non-Involved Workers[(e)]**	**Onsite & for Offsite Treatment: Includes Transport Crew, Public, and Non-Involved Workers, Fatalities[(f)]**	**Onsite & for Offsite Treat-ment**	**Incoming LLW, MLLW & TRU Waste Within Oreg. State Only**	**Incoming LLW, MLLW & TRU Waste Within Wash. State Only**	**TRU Waste to WIPP**	**Shrub-Steppe Habitat Disturbed, ha**	**Geologic Resources Committed (sand, gravel, silt/loam, and basalt), millions of m^3**	**Diesel Fuel Committed Thousands of m^3**	**Cost in Billions of 2002 Dollars**
Group A	<1/million	<1/million	0 (<0.001)	0 (<0.50)	30	1	1	20/1	2-4/0	1/0	18/3	32	2.4 -2.5	133 - 134	3.7 - 4.0
Group B	<1/million	<1/million	0 (<0.001)	0 (<0.50)	30	1	0	1/0	2-4/0	1/0	18/3	0	2.6 - 2.8	137 - 141	3.8 - 4.2
Group C	<1/million	<1/million	0 (<0.001)	0 (<0.50)	30	1	1	20/1	2-4/0	1/0	18/3	14	2.2 - 2.3	66 - 67	3.5 - 3.9
Group D_1	<1/million	<1/million	0 (<0.001)	0 (<0.50)	30	1	1	20/1	2-4/0	1/0	18/3	19 - 25	2.2 - 2.3	66 - 67	3.2 - 3.5
Group D_2	<1/million	<1/million	0 (<0.001)	0 (<0.50)	30	1	1	20/1	2-4/0	1/0	18/3	0	2.2 - 2.3	66 - 67	3.2 - 3.5
Group D_3	<1/million	<1/million	0 (<0.001)	0 (<0.50)	30	1	1	20/1	2-4/0	1/0	18/3	0	2.2 - 2.3	66 - 67	3.2 - 3.5
Group E_1	<1/million	<1/million	0 (<0.001)	0 (<0.50)	30	1	1	20/1	2-4/0	1/0	18/3	0	2.2 - 2.3	66 - 67	3.4 - 3.8
Group E_2	<1/million	<1/million	0 (<0.001)	0 (<0.50)	30	1	1	20/1	2-4/0	1/0	18/3	5 - 11	2.2 - 2.3	66 - 67	3.4 - 3.8
Group E_3	<1/million	<1/million	0 (<0.001)	0 (<0.50)	30	1	1	20/1	2-4/0	1/0	18/3	14	2.2 - 2.3	66 - 67	3.4 - 3.8
No Action	<1/million	<1/million	0 (<0.001)	1 (0.52)	30	1	0	1/0	0	0	9/1	10	1.4	187	3.5 - 3.5

(a) Where a single value is given, the value applies to both Hanford Only and Upper Bound waste volumes.
(b) Where a single value is given, the value applies to both Hanford Only and Lower Bound waste volumes.
(c) Unlike the Alternative Groups where the risk of this accident would be over about 43 years, the risk would continue as long as waste is stored in CWC.
(d) Excludes transport in general of wastes from offsite generators, the impacts for which the PEIS should be consulted.
(e) For the "involved" worker(s) that might be in a CWC building during such an event the consequences could range from none to several fatalities from collapse of the building.
(f) Includes inferred fatalities from radiation exposure and vehicular emissions.

Table 3.8. Summary Comparison of Long-Term (10,000 years) Impacts Among the Alternatives

Hanford Only to Upper Bound Waste Volume - Alternative Groups A-E[a]											
Hanford Only and Lower Bound Waste Volume for No Action Alternative[b]											
Alternative	Additional Land Permanently Committed to Disposal, ha	Exposure to Radionuclides Via Groundwater Pathway								Maximum Waste Site Intruder Risk of Fatality at 100 Years After Closure[e]	
		Maximum Annual Drinking Water Dose, mrem		Chances in a <u>Million</u> of Fatality (LCF) to Lifetime Onsite Resident Gardener		Chances of Fatality (LCF) for Lifetime Onsite Resident Gardener <u>with Sauna/Sweat Lodge</u>		Fatalities (LCFs) in Populations over 10,000 years[d]			
		200 Areas	Near River	200 Areas[f]	Near River	200 Areas[g]	Near River	Tri-Cities	Portland	Drilling	Excavation
Group A	38 - 47	0.46 - 2.2	0.05 - 0.09	65 - 120	7	1 in 400 - 1 in 10	1 in 4000 - 1 in 300	0	0	4 in 100	Precluded
Group B	56 - 80	0.46 - 2.4	0.12 - 0.21	64 - 130	13 - 15	1 in 100 - 1 in 10	1 in 200 - 1 in 100	0	0	4 in 100	Precluded
Group C	20 - 29	0.46 - 2.2	0.05 - 0.09	65 - 120	7	1 in 400 - 1 in 10	1 in 4000 - 1 in 300	0	0	4 in 100	Precluded
Group D$_1$	19 - 25	0.26 - 2.2	0.06 - 0.09	37 - 120	8 - 9	1 in 400 - 1 in 10	1 in 2000 - 1 in 300	0	0	4 in 100	Precluded
Group D$_2$	19 - 25	0.34 - 2.3	0.08 - 0.09	45 - 120	11	1 in 200 - 1 in 10	1 in 2000 - 1 in 300	0	0	4 in 100	Precluded
Group D$_3$	19 - 25	0.46 - 2.3	0.06 - 0.09	63 - 120	8	1 in 400 - 1 in 10	1 in 2000 - 1 in 300	0	0	4 in 100	Precluded
Group E$_1$	19 - 25	0.34 - 2.3	0.08 - 0.09	45 - 120	11	1 in 400 - 1 in 10	1 in 2000 - 1 in 300	0	0	4 in 100	Precluded
Group E$_2$	19 - 25	0.21 - 0.26	0.05 - 0.10	28 - 29	6 -7	1 in 400 - 1 in 10	1 in 2000 - 1 in 200	0	0	4 in 100	Precluded
Group E$_3$	19 - 25	0.27 - 2.3	0.06 - 0.09	39 - 120	8	1 in 400 - 1 in 10	1 in 2000 - 1 in 300	0	0	4 in 100	Precluded
No Action	86 - 95[c]	0.51-0.99	0.04	43	6	1 in 50	1 in 800	0	0	4 in 100	Likely a Fatality[g]

(a) Where a single value is given the value applies to both Hanford Only and Upper Bound waste volumes.
(b) Where a single value is given the value applies to both Hanford Only and Lower Bound waste volumes.
(c) Includes land for storage of waste in CWC.
(d) Zero inferred latent cancer fatalities. Constant populations; Tri-Cities -113,000; Portland 510,000.
(e) Risk value given assumes that the event takes place.
(f) Location within the 200 Areas having the highest results.
(g) Very high dose would possibly lead to fatality.

3.4.1 Land Use

Land permanently committed to HSW disposal includes about 130 ha (320 ac) already occupied by waste previously disposed of in LLBGs. Disposal of the Hanford Only waste volume would increase land permanently committed for disposal from a low of 19 ha (47 ac) for Alternative Groups C through E, to a high of 56 ha (140 ac) for Alternative Group B (Land Use values are rounded and may not add or convert exactly). Similarly the increases for the Lower Bound waste volume would range from 20 ha (49 ac) to 59 ha (150 ac) for the same alternative groups. The increases for the Upper Bound waste volume would range from 25 ha (62 ac) to 80 ha (200 ac) for the same alternative groups. In the No Action Alternative the increase in land permanently committed to disposal would be 28 ha (69 ac), which, however, does not take into account an increase in land usage of 66 ha (160 ac) for facilities committed to storage of LLW, MLLW, and TRU waste. The areas of land to be committed are shown for comparison among the alternatives in Table 3.9.

Table 3.9. Comparison of Land Area Permanently Committed in the Various Alternatives as of 2046, ha[(a)]

Alternative	Hanford Only Waste Volume			Lower Bound Waste Volume			Upper Bound Waste Volume		
	LLW & MLLW Increase	ILAW Increase	Total Land Committed[(b)]	LLW & MLLW Increase	ILAW Increase	Total Land Committed[(b)]	LLW & MLLW Increase	ILAW Increase	Total Land Committed[(b)]
Alternative Group A	12	26	**168**	13	26	**170**	21	26	**178**
Alternative Group B	30	26	**187**	33	26	**189**	54	26	**210**
Alternative Group C	12	8	**151**	13	8	**152**	21	8	**160**
Alternative Groups D & E	11	8	**150**	12	8	**150**	17	8	**155**
No Action Alternative	17	10	**274**[(c)]	19	10	**275**[(c)]	Not applicable		

(a) One hectare (ha) = about 2.5 acre (ac). Values may not add exactly due to rounding.
(b) Includes 130 ha already committed for HSW previously disposed of in the LLBGs.
(c) Includes 116 ha for storage of waste in CWC buildings.

3.4.2 Air Quality

Air quality impacts are based on estimated concentrations of criteria pollutants: particulate matter (PM_{10}), sulfur dioxide (SO_2), carbon monoxide (CO), and nitrogen dioxide (NO_2) at points of public occupancy. Table 3.10 presents the largest potential impacts calculated for each alternative group in comparison to Air Quality Standards. Air quality impacts for obtaining capping materials are presented separately following the table. Impacts from releases of radioactive material and chemicals to the atmosphere are addressed in Section 3.4.11 and 5.11, Human Health and Safety.

Table 3.10. Comparison Among the Alternative Groups of Estimated Criteria-Pollutant Impact Maximums for Solid Waste Operations in the 200 Areas, Percent of Air Quality Standards[(a)]

Alternative	Hanford Only and Lower Bound Waste Volumes				Upper Bound Waste Volume			
	24-Hour PM_{10}	1-Hour SO_2	8-Hour CO	Annual NO_2	24-Hour PM_{10}	1-Hour SO_2	8-Hour CO	Annual NO_2
Alternative Group A, %	46	8.1	4.7	0.84	49	9.8	5.9	0.8
Alternative Group B, %	47	13	8	1.0	60	18	11	1.1
Alternative Group C, %	40	7.9	4.6	0.79	41	8.0	4.7	0.78
Alternative Group D, %	41	8.4	5.0	0.91	41	8.4	5.0	0.98
Alternative Group E, %	40	9.3	5.3	0.84	41	9.5	5.3	0.97
No Action Alternative, %	38	8.6	4.6	0.93	Not applicable			
(a) (24-Hour PM_{10} = 150 $\mu g/m^3$, 1-Hour SO_2 = 1,000 $\mu g/m^3$, 8-Hour CO = 10,000 $\mu g/m^3$, Annual NO_2 = 100 $\mu g/m^3$)								

Maximum air quality impacts from operating the Area C borrow pit would amount to 14 percent of the 24-Hour Standard for PM_{10}, 26 percent of the 1-Hour Standard for SO_2, 36 percent for the 8-Hour Standard for CO, and 0.16 percent of the Annual Standard for NO_2, but would be common to all alternatives.

For the most part the impacts on air quality are essentially the same for all alternatives. An exception is Alternative Group B where the impacts for some pollutants are below standard values, but noticeably higher than for the other alternatives due to the increased excavation required for construction of disposal trenches.

3.4.3 Water Quality

As a result of wastewater management activities during past Hanford Site operations, groundwater beneath the 200 Areas has been contaminated with radionuclides and non-radioactive chemicals. The contaminants emanating from the 200 Areas are moving toward the Columbia River. None of these contaminants are thought to have originated from existing LLBGs or other waste management facilities being considered in the HSW EIS. Uncertainties regarding levels of chemicals previously disposed of in LLBGs are discussed in Section 3.5.

One benchmark measure of water quality for purposes of comparison among the alternatives is taken as the percentage of Maximum Contaminant Levels (MCLs)[(a)] in groundwater. The percentage of MCLs

(a) Maximum Contaminant Levels (MCLs), defined in 40 CFR 141, apply to drinking water supplies. Although groundwater beneath the Hanford Site is not a drinking water supply the MCLs provide a useful benchmark against which to compare contaminant levels.

is calculated for hypothetical wells intercepting maximum cumulative concentrations of radionuclides in predicted plumes along several lines of analysis downgradient from the HSW disposal facilities. These lines of analysis were positioned at a distance to capture contributions from all HSW disposal facilities within 200 West Area, at the ERDF, and 200 East Area including possible contributions from the 200 West Area and ERDF sources. The specific lines of analysis considered in this assessment are as follows:

- a line of analysis 1 km downgradient from waste disposed of in the 200 West Area LLBGs or the ILAW waste disposal facility near CWC (referred to as the 200 West Line Of Analysis [LOA] in Section 5.3 and Appendix G).

- a line of analysis about 1 km downgradient to the northwest from the 200 East LLBGs (referred to as the 200 East NW LOA in Section 5.3 and Appendix G). This LOA was used to evaluate concentrations in groundwater migrating northwest of the 200 East Area.

- a line of analysis about 1 km downgradient to the southeast from a new disposal facility near the PUREX Plant (referred to as the 200 East SE LOA in Section 5.3 and Appendix G). This LOA was used to evaluate concentrations in groundwater migrating southwest of the 200 East Area.

- a line of analysis about 1 km downgradient from the ERDF location (referred to as the ERDF LOA in Section 5.3 and Appendix G).

- a line of analysis along the Columbia River (referred to as the Columbia River LOA in Section 5.3 and Appendix G).

The highest percentages of MCLs together with the time of occurrence are given in Table 3.11 for the period ending in about 10,200 AD. In that time period technetium-99 and iodine-129 are the principal contaminants of interest. After about 10,200 AD uranium begins to dominate as the principal contaminant in groundwater. The highest percentages of the MCL for uranium are given in Table 3.12.

Another benchmark measure of water quality for purposes of comparison among the alternatives is taken as the dose to an individual from drinking 2 liters per day of groundwater from the hypothetical wells described above. These doses are based on inventories by activity presented in Appendix B, groundwater transport analysis as described in Section 5.3 and Appendix G, and dose conversion factors based on Federal Guidance Reports 11 and 12, details of which are presented in Appendix F. The latter are Plots of maximum annual drinking water dose as a function of time are provided in Figures 3.4 to 3.8.[(a)]

(a) The period of analysis is 10,000 years after 2046 and the plots would end at 12,046, however the plots are constrained by the software to the next whole millennium.

Table 3.11. Highest Percentage of Maximum Concentration Levels (MCLs) to the Year 10,200 AD[a,b]

Hanford Only Waste Volume																				
Alternative	**200 W Well Location**				**ERDF Well Location**				**200E NW Well Location**				**200 E SE Well Location**				**River Well Location**			
	I-129	Tc-99	**Total**	Yr AD	I-129	Tc-99	**Total**	Yr AD	**I-129**	**Tc-99**	**Total**	Yr AD	I-129	Tc-99	**Total**	Yr AD	I-129	Tc-99	**Total**	Yr AD
Group A	57	1	**58**	2270	Not applicable				84	1	**85**	3400	2	3	**5**	12050	14	4	**18**	3680
Group B	57	1	**58**	2250					84	1	**85**	3400	Not applicable				15	3	**18**	3490
Group C	57	1	**58**	2270					84	1	**85**	3400	2	3	**5**	12050	14	4	**18**	3680
Group D_1	57	1	**58**	2250					56	2	**58**	2100	63	0.1	**63**	2420	7	4	**11**	3560
Group D_2	57	1	**58**	2250					86	15	**100**	3400	Not applicable				14	4	**18**	3660
Group D_3	57	1	**58**	2250	93	24	**117**	3790	56	2	**58**	2090					12	3	**15**	4060
Group E_1	57	1	**58**	2250	22	27	**49**	12050	86	15	**100**	3400					14	4	**18**	3650
Group E_2	57	1	**58**	2250	22	27	**49**	12050	56	2	**58**	2100	63	0.1	**63**	2420	8	3	**11**	3580
Group E_3	57	1	**58**	2250	92	23	**115**	3790	56	2	**58**	2080	2	3	**5**	12050	11	3	**15**	3710
No Action	80	2	**82**	2080	Not applicable				56	2	**58**	2080	Not applicable				4	2	**6**	4020
Upper Bound Waste Volume																				
Alternative	**200 W Well Location**				**ERDF Well Location**				**200E NW Well Location**				**200 E SE Well Location**				**River Well Location**			
	I-129	Tc-99	**Total**	Yr AD	I-129	Tc-99	**Total**	Yr AD	I-129	Tc-99	**Total**	Yr AD	I-129	Tc-99	**Total**	Yr AD	I-129	Tc-99	**Total**	Yr AD
Group A	57	1	**58**	2270	Not applicable				93	10	**103**	3390	2	3	**5**	12050	14	4	**18**	3650
Group B	57	1	**58**	2250					123	13	**136**	3290	Not applicable				17	4	**21**	3480
Group C	57	1	**58**	2270					93	10	**103**	3390	2	3	**5**	12050	14	4	**18**	3650
Group D_1	57	1	**58**	2250					56	2	**58**	2090	72	16	**88**	3380	10	5	**14**	3540
Group D_2	57	1	**58**	2250					95	16	**111**	3380	Not applicable				15	5	**19**	3630
Group D_3	57	1	**58**	2250	95	25	**120**	3800	56	2	**58**	2090					12	4	**16**	4050
Group E_1	57	1	**58**	2250	22	27	**49**	12050	95	16	**111**	2690					14	4	**18**	3670
Group E_2	57	1	**58**	2250	22	27	**49**	12050	56	2	**58**	2090	72	16	**88**	3340	8	3	**11**	3580
Group E_3	57	1	**58**	2250	93	23	**116**	3800	56	2	**58**	2090	2	3	**5**	12050	12	4	**15**	3730
No Action	Not applicable																			

(a) MCL for Tc-99 is 900 pCi/L and for I-129 is 1 pCi/L.
(b) Some of the numbers do not add exactly due to rounding.

Table 3.12. Highest Percentage of Maximum Concentration Levels (MCLs) from 10,200 to 12,050 AD - All Due to Uranium[(a)]

	Hanford Only Waste Volume					Upper Bound Waste Volume				
Alternative	200 W Well	ERDF Well	200E NW Well	200 E SE Well	River Well	200 W Well	ERDF Well	200E NW Well	200 E SE Well	River Well
	%	%	%	%	%	%	%	%	%	%
Group A	<0.1	NA	0.1	1	<0.1	<0.1	NA	55	1	2
Group B	3	NA	3	NA	3	4	NA	58	NA	5
Group C	<0.1	NA	0.1	1	<0.1	<0.1	NA	55	1	<0.1
Group D_1	<0.1	NA	0.1	0.1	1	0.1	NA	55	1	3
Group D_2	<0.1	NA	2.0	NA	<0.1	0.1	NA	56	NA	2
Group D_3	<0.1	4	0.1	NA	<0.1	0.1	4	55	NA	2
Group E_1	<0.1	4	0.3	NA	<0.1	0.1	4	55	NA	2
Group E_2	<0.1	4	0.1	0.1	0.1	0.1	4	55	<0.1	2
Group E_3	<0.1	<0.1	0.1	1	<0.1	<0.1	0	55	1	2
No Action	<0.1	NA	13	NA	0.3	Not applicable				
(a) MCL for uranium is 30 micrograms per liter.										

Maximum doses from drinking water containing combined radionuclide concentrations predicted at all lines of analysis in groundwater for any of the alternatives and waste volumes fall below 1 mrem/yr for the first 1,000 years after disposal, and below the 4 mrem/yr drinking water standard,[(a)] that is used as a benchmark for performance, for the entire 10,000-year period of analysis. The combined dose from drinking maximum radionuclide concentrations predicted adjacent to the Columbia River is less than 0.1 mrem/yr for about 9,000 years and does not exceed 1 mrem/yr for the 10,000-year period of analysis. Results from modeling indicate potential increases in the dose near the end of the 10,000-year period because of the arrival of uranium in groundwater.

LLW disposed of prior to September 1987 may contain hazardous chemical constituents, but no specific requirements existed to account for or report the content of hazardous chemical constituents in this category of LLW. As a consequence, analysis of these constituents and estimated impacts based on the limited amount of information on estimated inventories and waste disposal locations would be subject to substantial uncertainty at this time. (Additional discussion on uncertainties is presented in Section 3.5.) Regardless the fate of these chemical-bearing wastes would be capped under all of the alternative groups. A distinction as to their fate would, however, be made for the No Action Alternative where the LLBGs would not be capped.

(a) Drinking water standards promulgated by the EPA as Primary Drinking Water Standards (40 CFR 141) under the Safe Drinking Water Act are applicable to treated water at the tap, and therefore are not directly applicable to groundwater quality. However, the 4 mrem/yr standard provides a benchmark against which to compare the values shown in the figures.

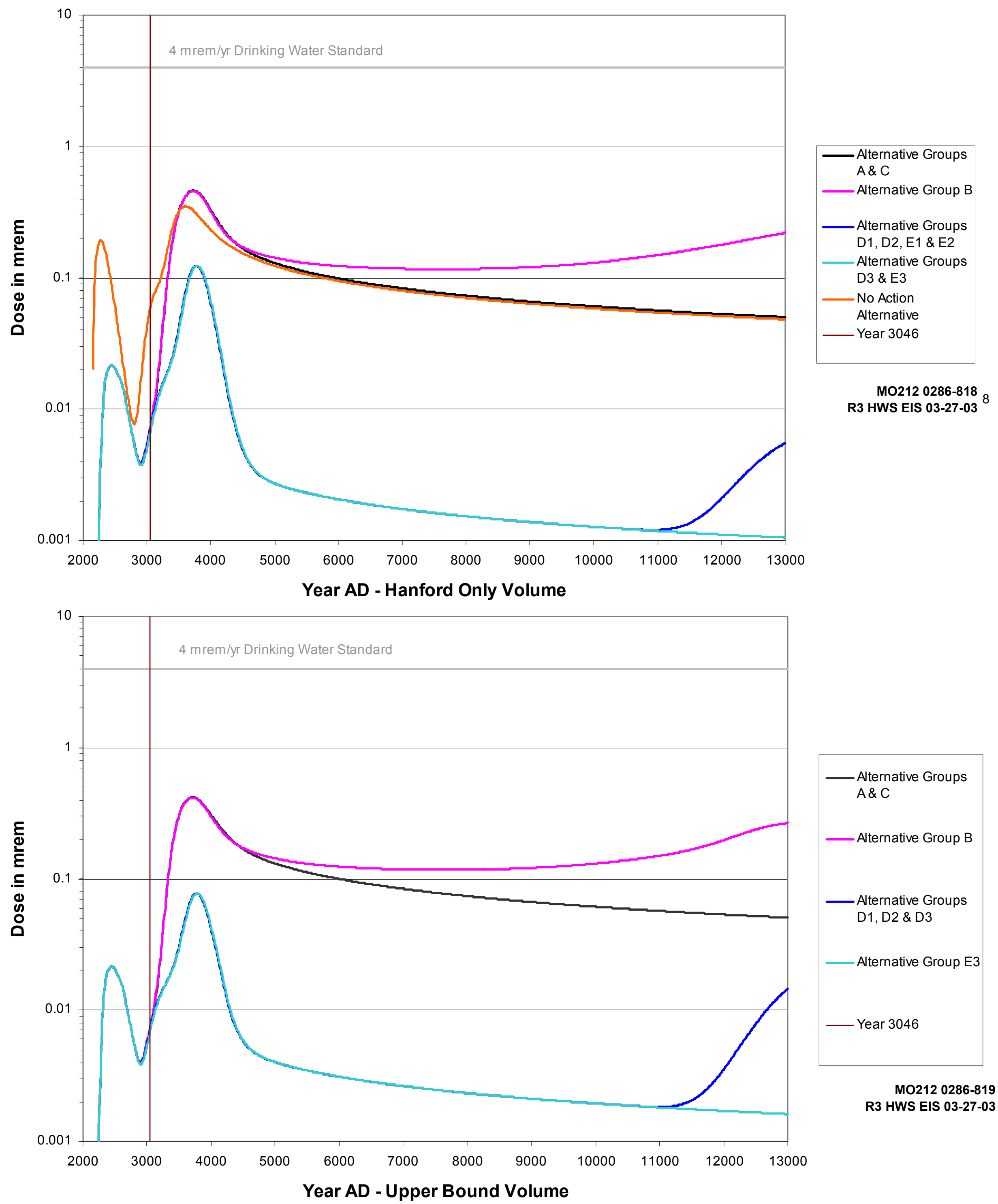


Figure 3.4. Annual Dose from Drinking Water Containing Maximum Concentrations of Radionuclides in Groundwater at 1 km Downgradient from the 200 West Area Disposal Facilities as a Function of Calendar Year, Hanford Only and Upper Bound Waste Volumes

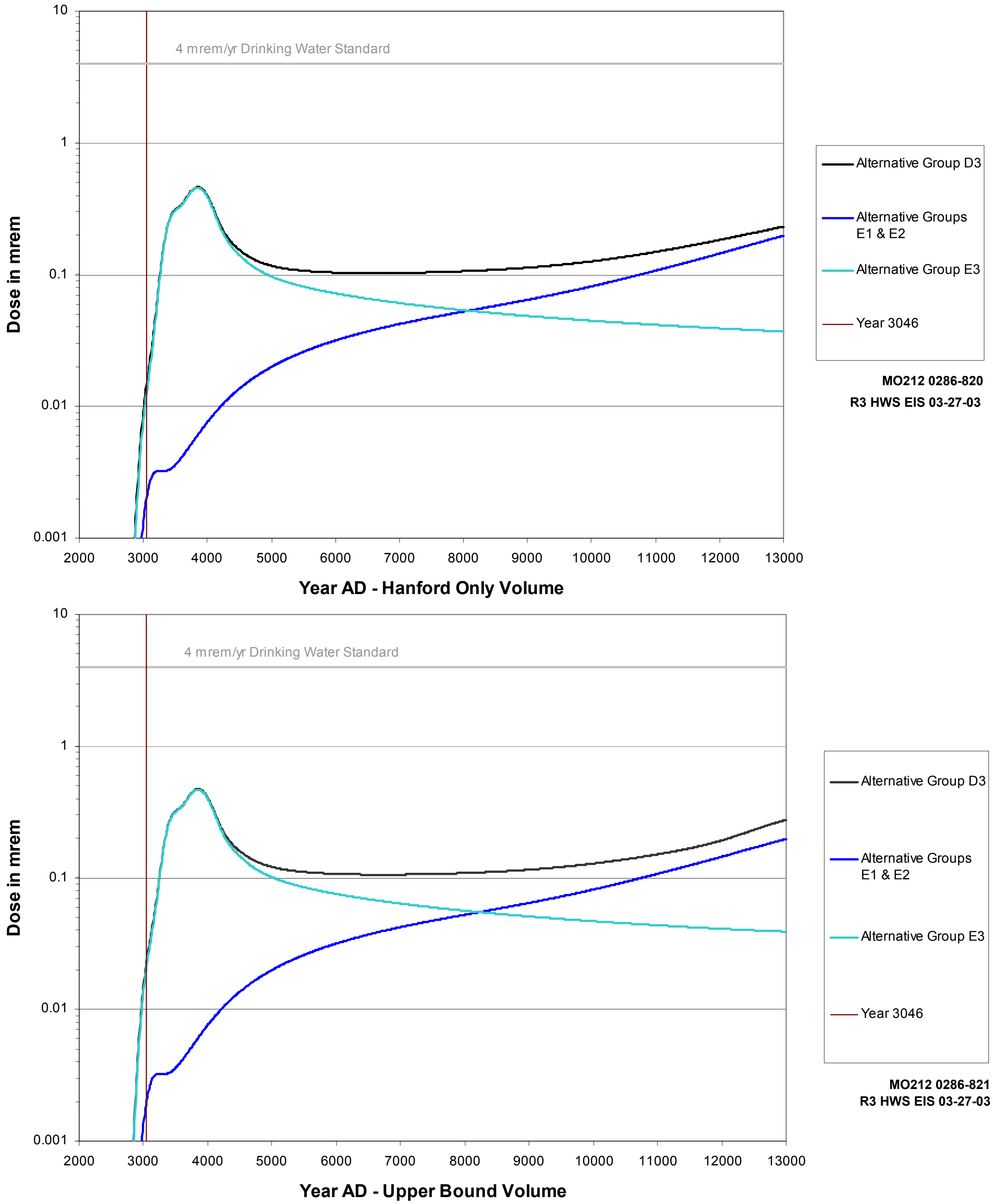


Figure 3.5. Annual Dose from Drinking Water Containing Maximum Concentrations of Radionuclides in Groundwater at 1 km Downgradient from ERDF as a Function of Calendar Year, Hanford Only and Upper Bound Waste Volumes

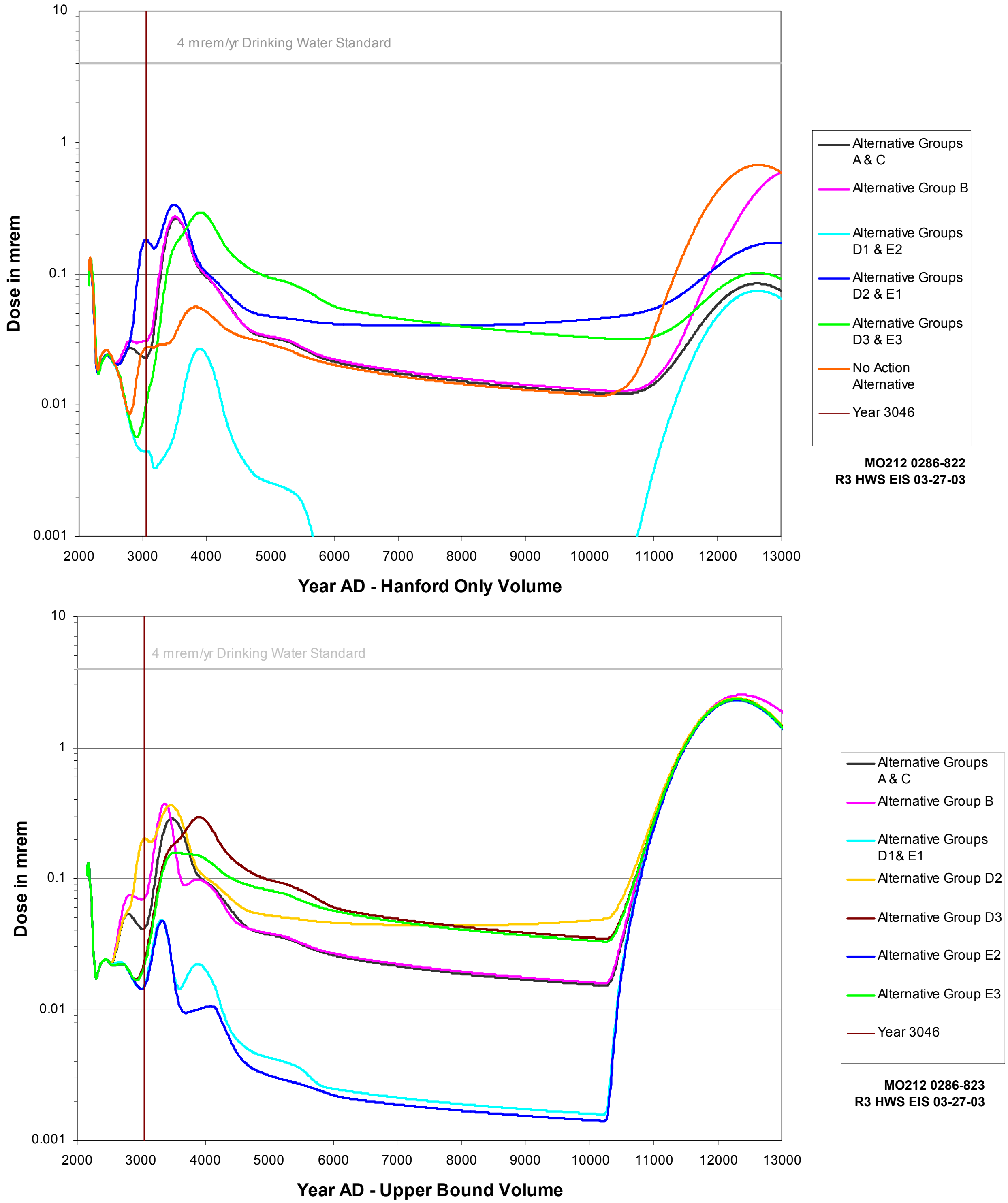


Figure 3.6. Annual Dose from Drinking Water Containing Maximum Concentrations of Radionuclides in Groundwater at 1 km Northwest Downgradient from the 200 East Area as Disposal Facilities as Function of Calendar Year, Hanford Only and Upper Bound Waste Volumes

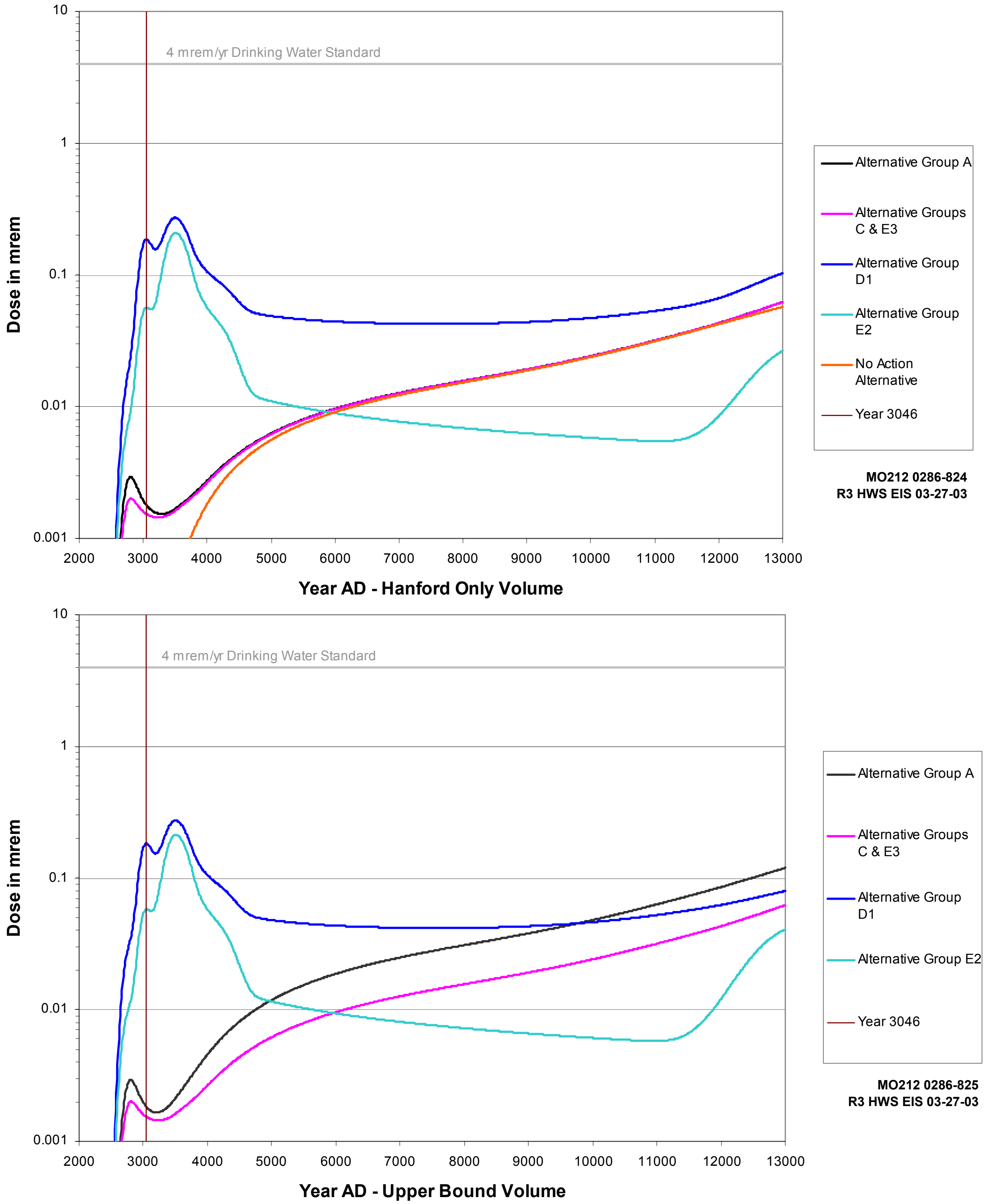


Figure 3.7. Annual Dose from Drinking Water Containing Maximum Concentrations of Radionuclides in Groundwater at 1 km Downgradient Southeast from the 200 East Area Disposal Facilities as a Function of Calendar Year, Hanford Only and Upper Bound Waste Volumes

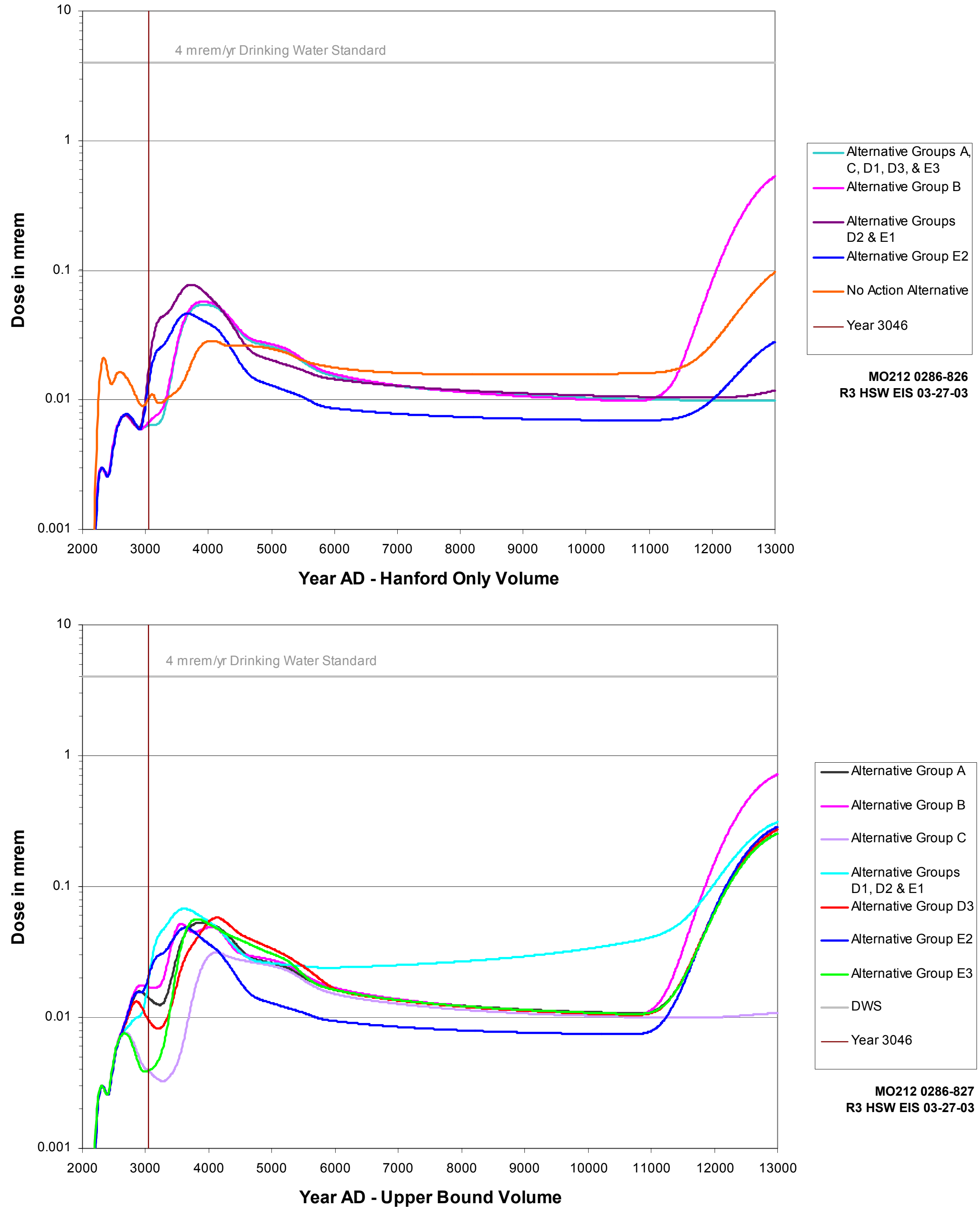


Figure 3.8. Annual Dose from Drinking Water Containing Maximum Concentrations of Radionuclides in Groundwater Near the Columbia River as a Function of Calendar Year, Hanford Only and Upper Bound Waste Volumes

Estimated inventories of hazardous chemical constituents associated with LLW and MLLW disposed of after 1988 being considered under each alternative group would be expected to be found at trace levels. MLLW, which would be expected to contain the majority of hazardous chemical constituents, would undergo predisposal solidification to stabilized waste forms and containment and thermal treatment to remove organic chemical components of the MLLW. This waste treatment would be done to meet current waste acceptance criteria and land disposal restrictions before being disposed of in permitted MLLW facilities. Consequently, groundwater quality impacts from these constituents would not be expected to be substantial.

Based on the analysis presented in Section 5.3 and Appendix G, Alternative Groups D and E tend to be the most protective.

3.4.4 Geologic Resources

Although large quantities of gravel, silt/loam, and basalt would be needed for capping waste disposal facilities upon closure, these resources are readily available in the Area C borrow pit. A comparison among the alternatives of quantities that would be needed is shown in Table 3.13.

Table 3.13. Comparison of Commitments of Geologic Resources, Millions of m^{3}[(a)]

Alternative	Hanford Only Waste Volume	Lower Bound Waste Volume	Upper Bound Waste Volume
Alternative Group A	2.4	2.4	2.5
Alternative Group B	2.5	2.6	2.8
Alternative Group C	2.2	2.2	2.3
Alternative Group D	2.2	2.2	2.3
Alternative Group E	2.2	2.2	2.3
No Action Alternative	1.4	1.4	Not Applicable
(a) 1 m^3 = about 1.3 yd^3.			

3.4.5 Ecological Resources

Impacts on ecological resources, other than disturbance of shrub-steppe habitat, were determined to be low and sufficiently similar among the alternative groups and the No Action Alternative that they would not be expected to be an important discriminator in the alternative selection process. Disturbance of shrub-steppe habitat would be related to alternative groups making use of the near PUREX disposal facility, which is in an area that was not burned over in the 24 Command Fire of June 2000. There, the area of disturbance ranged from zero in the case of Alternative Groups B, D_2, D_3, and E_1 to 32 ha (79 ac) for Alternative Group A. Other alternative groups and the No Action Alternative were intermediate with 5–25 ha (12-62 ac) of disturbance depending on waste volume disposed of (see Table 3.4). Conclusions regarding potential impacts on terrestrial biota at the disposal facility near PUREX were based on spring/summer surveys conducted from 1998 to 2002. Conclusions regarding potential impacts on aquatic and riparian biota near and in the Columbia River were based on an ecological risk assessment of potential future releases from waste sites through groundwater to the river. Details of the analysis are presented in Section 5.5 with additional information in Appendix I.

3.4.6 Socioeconomics and Environmental Justice

Implementation of any of the HSW EIS alternative groups or the No Action Alternative would have small and barely differentiable impacts on local socioeconomic infrastructure, including housing, schools, medical support, traffic, etc. Details of the analysis are presented in Section 5.6. No particular distinction was made among any of the alternatives for impacts on environmental justice (see Section 5.13).

3.4.7 Cultural, Aesthetic, and Scenic Resources

The principal potential for impacts on cultural resources in implementing any of the alternative groups or the No Action Alternative would be associated with disturbance of the surface and near surface portions of the Area C borrow pit. Although archeological sites might be found in Area C, a recent field reconnaissance failed to reveal any archeological sites or artifacts on the surface. Because construction would be halted in the event that an artifact of possible cultural significance is found and will remain so until a professional evaluation is made, it is unlikely that impact to cultural resources would be an important discriminator among the alternatives. Details of the analysis are presented in Sections 5.7 and Appendix K.

No particular distinction was made among any of the alternative groups for impacts on aesthetic and scenic resources; the most noticeable change would be the potential impact on the viewshed from nearby prominences as a result of obtaining capping materials from Area C (see Section 5.12).

3.4.8 Transportation

The measure of impacts from transportation for comparison among the alternatives was taken as the number of fatalities resulting from transport of wastes and construction materials for the Hanford Only waste volume. Those impacts include offsite transport of MLLW for treatment in all Alternative Groups except B. These values are presented in Table 3.14. Details of the transportation analysis are presented in Section 5.8 and Appendix H.

Transport of wastes from offsite is the same for all alternative groups. The potential impacts of offsite transportation were previously evaluated in the WM PEIS and the WIPP SEIS-2 and are incorporated by reference (DOE 1997b and DOE 1997a, respectively). Impacts within the states of Oregon and Washington that might occur from shipping waste to and from the Hanford Site were analyzed and are summarized in Table 3.15.

Table 3.14. Summary Comparison of Radiological and Non-Radiological Transportation Impacts – Hanford Only Waste Volumes

Alternative	Radiological			Non-radiological		
	Incident-free		Accidents			
	Crew - Fatalities	Public - Fatalities	Accidents Fatalities	Number of Accidents	Accident Fatalities	Emissions Fatalities
Alternative Groups A, C, D, and E[(a)]	**0** (0.45)	**0** (0.15)	**0** (0.027)	**20**	**1** (0.52)	**0** (0.38)
Alternative Group B[(b)]	**0** (0.068)	**0** (0.055)	**0** (0.027)	**1** (0.78)	**0** (0.049)	**0** (0.28)
No Action Alternative[(c)]	**0** (0.075)	**0** (0.047)	**0** (0.024)	**1** (1.2)	**0** (0.055)	**1** (0.27)

Note: Public includes non-involved workers. Numbers in parentheses are the calculated values. Accidents and fatalities occur as whole numbers and calculated values are rounded to whole numbers.

(a) The impacts in these Alternative Groups are for the Hanford Only waste volume case. The differences between this case and the Upper and Lower Bound waste volume case of additional offsite-generated waste are shown in Table 3.15., for Oregon and Washington only. Impacts of nation-wide transport of wastes were discussed previously in the PEIS.

(b) Offsite shipments are minimal in Alternative Group B for all waste volume cases.

(c) There are no offsite shipments associated with the No Action Alternative.

Table 3.15. Impacts in Oregon and Washington from Offsite Shipments of Solid Wastes to and from Hanford

Shipping Segment	Radiological Impacts			Non-radiological Impacts		
	Incident Free Worker Fatalities	Incident Free Public Fatalities	Accident Fatalities	Number of Accidents	Accident Fatalities	Emissions Fatalities
Lower Bound Waste Volume						
Oregon	0.054	0.042	0.0017	2.2	0.0031	0.025
Washington	0.013	0.0093	0.00040	0.52	0.0080	0.0025
Total	**0** (0.067)	**0** (0.051)	**0** (0.0021)	**3** (2.7)	**0** (0.039)	**0** (0.031)
Upper Bound Waste Volume						
Oregon	0.17	0.11	0.10	3.6	0.063	0.047
Washington	0.039	0.024	0.026	0.85	0.015	0.011
Total	**0** (0.21)	**0** (0.13)	**0** (0.13)	**5** (4.5)	**0** (0.078)	**0** (0.058)

As shown in the Table 3.15 transport of waste from offsite generators might result in two accidents in Oregon and 1 in Washington for the Lower Bound waste volume and 4 accidents in Oregon and one in Washington for the Upper Bound waste volume. No fatalities were forecast in either case.

Transport of TRU waste to WIPP for Alternative Groups A through E might result in 18 accidents and 3 fatalities, and for the No Action Alternative, 9 accidents and 1 fatality, although not predicted to occur in the states of Oregon or Washington.

One to four accidents were calculated to occur during transport of construction and capping materials for Alternative Groups A – E, and four accidents were estimated for the No Action Alternative. No fatalities were forecast in any case.

3.4.9 Noise

Since all alternatives would involve essentially the same activities, noise levels produced by those activities at any given point in time would be essentially the same. Noise was not considered to be an important impact element, because of distance to public receptors. Wildlife that might be disturbed by noise near the Area C borrow pit would likely move to more acceptable locations. Details of the analysis of noise are presented in Section 5.9 and Appendix J. Based on the level of activity associated with waste management operations and their location within the Hanford Site, noise levels are predicted to be well within allowable limits at locations occupied by members of the public.

3.4.10 Resource Commitments

Resources committed to implementing the various alternative groups and the No Action Alternative would include land, the vadose zone beneath the disposal facilities, groundwater beneath the disposal sites and on to where it empties into the Columbia River, various amounts of fossil fuel, electricity, steel, concrete, gravel, sand, gravel, silt/loam, basalt, water and other materials. Land Use and geologic resources have been described previously (Tables 3.9 and 3.13). Comparison of fossil fuel commitments among the alternatives is provided in Table 3.16. Alternative Groups A and B, and the No Action Alternative have generally higher demand for fossil fuels than the other alternatives because of additional construction and operation required. Details of the analysis of resource commitments are presented in Section 5.10.

3.4.11 Human Health and Safety

Comparison of human health and safety among the alternatives is expressed in terms of worker dose, dose to the public from atmospheric releases, accidents during the operational period, and long-term impacts via the groundwater pathway in the post-closure period. Details of the analyses are provided in Section 5.11 and Appendix F. Intruder scenarios and consequences are essentially the same for all alternative groups. The exception would be for the basement excavation scenario in the No Action Alternative where only the Trenches 31 and 34 containing MLLW are capped. The depth of capping material would be expected to preclude the occurrence of that scenario for those wastes.

Table 3.16. Comparison of Fossil Fuel Commitments Among the Alternatives[(a)]

Alternative	Diesel, $m^{3(b)}$ Hanford Only Waste Volume	Diesel Lower Bound Waste Volume	Diesel Upper Bound Waste Volume	Gasoline, m^3 Hanford Only Waste Volume	Gasoline Lower Bound Waste Volume	Gasoline Upper Bound Waste Volume	Propane, tonnes Hanford Only Waste Volume	Propane Lower Bound Waste Volume	Propane Upper Bound Waste Volume
Alternative Group A	132,900	132,900	133,700	260	260	270	12,700	12,700	19,300
Alternative Group B	136,600	136,700	140.600	340	340	430	23,500	23,500	38,300
Alternative Group C	65,900	65,900	66,700	260	260	270	12,700	12,700	19,300
Alternative Group D	65,900	65,900	66,700	260	260	270	18,800	20,300	27,800
Alternative Group E	65,900	65,900	66,700	260	260	270	18,800	20,300	27,800
No Action Alternative	188,600	188,700	Not Applicable	48	50	Not Applicable	3,560	3,560	Not Applicable

(a) 1 tonne = about 1.1 ton.
(b) Includes 120,100 m^3 for ILAW in Alternative Groups A and B, 53,100 m^3 for ILAW in Alternative Groups C, D, and E, and 183,400 m^3 for ILAW in the No Action Alternative.

3.4.11.1 Operational Period – Normal Operations

Radiological impacts to workers from air emissions and routine occupational radiation exposure through 2046 are compared among the alternatives in Table 3.17. No latent cancer fatalities (LCFs) would be expected from doses associated with any of the action alternatives; however, one LCF might be inferred from the No Action Alternative.

Radiological impacts on the public from the release of radioactive material to the atmosphere during routine operations through 2046 are compared among the alternatives in Table 3.18. (For more details, see Section 5.11.) No latent cancer fatalities would be expected from the doses presented.

3.4.11.2 Operational Period – Accidents

The consequences of industrial accidents on workers through 2046 are compared among the alternatives in Table 3.19.

Impacts on public health and safety from processing chemicals through 2046 are compared among the alternatives in Table 3.20.

For chemicals, there is no difference in impacts between the Hanford Only and the Lower Bound Volume cases because the difference in MLLW processing is small (0.4 percent volume difference).

Table 3.17. Comparison of Worker Health Impacts

Alternative	Non-Involved Worker, mrem[(a)]			Occupational Exposure, person-rem[(b)]		
	Hanford Only Waste Volume	Lower Bound Waste Volume	Upper Bound Waste Volume	Hanford Only Waste Volume	Lower Bound Waste Volume	Upper Bound Waste Volume
Alternative Group A	0.48	0.58	0.89	765	766	774
Alternative Group B	0.51	0.60	0.92	772	773	786
Alternative Group C	0.48	0.48	0.89	765	765	773
Alternative Groups D and E	0.48	0.58	0.89	767	767	778
No Action Alternative	0.48	0.58	Not Applicable	873	873	Not Applicable

(a) Lifetime dose to the hypothetical maximally exposed individual (MEI) based on the industrial worker scenario
(b) Work force external exposure from proximity to wastes

Table 3.18. Comparison of Public Health Impacts from Emissions of Radioactive Material to the Atmosphere During Routine Operations

Alternative	Population Dose, person-rem[(a)]			MEI Lifetime Dose, mrem[(b)]		
	Hanford Only Waste Volume	Lower Bound Waste Volume	Upper Bound Waste Volume	Hanford Only Waste Volume	Lower Bound Waste Volume	Upper Bound Waste Volume
Alternative Groups A, C, D, and E	0.11	0.13	0.27	0.0016	0.0018	0.0038
Alternative Group B	0.15	0.17	0.22	0.0021	0.0023	0.0032
No Action Alternative	0.078	0.094	Not Applicable	0.0011	0.0013	Not Applicable

(a) Collective population dose within 80 km (50 mi) based on the offsite resident gardener scenario as applied to average individuals in the population (see Appendix F).
(b) Lifetime dose to the hypothetical MEI based on the offsite resident gardener scenario.

Table 3.19. Comparison of Consequences of Industrial Accidents on Workers Among the Alternatives

Alternative	Total Recordable Cases		Lost work-day Cases		Lost Work Days	
	Hanford Only and Lower Bound Volume Cases	Upper Bound Volume Case	Hanford Only and Lower Bound Volume Cases	Upper Bound Volume Case	Hanford Only and Lower Bound Volume Cases	Upper Bound Volume Case
Alternative Groups A, C, D, and E	620	640	260	260	8900	9200
Alternative Group B	640	660	260	270	9000	9300
No Action Alternative	770	NA	320	Not Applicable	10,900	Not Applicable

Table 3.20. Comparison of Health Impacts on the Public from Routine Atmospheric Releases of Chemicals

Alternative	Hazard Quotient[(a)]		Cancer Incidence[(b)]	
	Hanford Only and Lower Bound Waste Volumes	Upper Bound Waste Volume	Hanford Only and Lower Bound: Waste Volumes	Upper Bound Waste Volume
Alternative Groups A, C, D, and E	1.1E-5	5.0E-5	1.2E-10	4.2E-10
Alternative Group B	3.8E-4	4.2E-4	7.0E-9	7.3E-9
No Action Alternative	5.3E-6	Not Applicable	8.9E-11	Not Applicable

(a) Peak annual hazard quotient values to the hypothetical MEI based on the offsite resident gardener scenario.
(b) Lifetime risk of cancer incidence to the hypothetical MEI based on the offsite resident gardener scenario.

No particular distinction was made among any of the alternatives for operational accidents involving either radiological or chemical materials. Details are provided in Section 5.11.

3.4.11.3 Post-Closure Period

Scenarios for intrusion into waste sites, soon after the time when active institutional control cannot be relied upon to prevent such action, include drilling through the waste in constructing a well and excavation of a basement for a dwelling house. The importance of these scenarios lies in the presence of short-lived radionuclides that may occur in quantity. In the case of drilling, the existence of a cap over the waste is assumed to constitute no deterrence. Inasmuch as the highest concentrations of radionuclides that are used in this analysis are common to all alternatives there would be no distinction among the alternatives based on this type of intrusion (the highest concentrations of radionuclides were determined to occur in waste previously disposed of in LLBGs). In the case of excavation for a basement, the depth to the top of the disposed waste is deep enough in all alternatives for which the waste sites are capped that the scenario is not considered credible. In the No Action Alternative where it is assumed that only the MLLW sites are capped, the depth to the top of the waste would be much less and waste could be encountered in the excavation. In any event these intruder scenarios, save for the No Action Alternative, do not provide a basis for discriminating among the alternatives. Details of these intruder analyses are presented in Section 5.11.2.2 and Appendix F.

Insights regarding the relative potential for impacts on the public over the long term may be obtained by examining the annual dose a hypothetical gardener might receive, if the individual were to intrude on the Hanford Site, drill a well (on the order of 80 to 90 m deep [about 250 ft]) into a contaminated aquifer, spread the drilling mud about the garden plot and use the well water for both domestic and irrigation purposes. Hypothetical wells near the disposal facilities are located 1 km (0.6 mi) from the aggregated waste sites in order to capture the front of the combined plume from the individual trenches. In addition, a well is modeled near the Columbia River where an individual might drill a shallow well rather than use debris-containing water directly from the river. Plots of the annual doses to the hypothetical resident gardener are provided in Figures 3.9 to 3.13. (The vertical line represents 1,000 years after closure of the disposal facilities.) Since the plots for the Hanford Only and Lower Bound waste volumes are essentially the same, plots are provided only for the Hanford Only and Upper Bound waste volumes. As may be seen in the figures, there are differences in the annual doses over time as a function of alternative, however the maximum values are all small compared to DOE's 25 mrem all pathways limit and, except for the period beginning about 9,000 years after disposal, the doses are below the drinking water standard of 4 mrem/yr.

To account for the possibility that the hypothetical gardener had a sauna, or hot tub; or in the case of a Native American, a sweat lodge, the annual dose to such an individual at any time during the 10,000-year analysis period was also determined. Plots of the annual doses to the resident gardener are compared among the alternatives in Figures 3.14 to 3.18. (Note that the vertical scale of Figure 3.16 is 10 times that for the remaining figures in the set.) The much higher doses associated with the sauna/sweat lodge scenario are attributable to inhalation of radionuclides released as a result of elevated water temperatures used in saunas or sweat lodges. For all alternatives the annual dose is at or less than 4 mrem for the first 1,000 years. Late in the 10,000-year period there is considerable difference among the alternatives with the risk of a latent cancer fatality ranging up to about 1 in 10 (about 2.5 rem/yr – 70 yr occupancy) for well locations on the 200 Areas plateau to about 3 in 100 (about 0.8 rem/yr) for a well adjacent to the Columbia River. This rise is due primarily to the late arrival of uranium in quantity in groundwater at some sites.

For perspective, it may be noted that a hypothetical gardener with sauna or sweat lodge, and using water drawn from the Columbia River at Priest Rapids upstream of the Hanford Site, could receive an annual dose of about 90 mrem from upstream sources of uranium (based on 5-year average measurements of the concentration of uranium in Columbia River water at Priest Rapids (Poston et al. 2002). Over a 70-yr period at such an annual dose a probability of latent cancer fatality of 0.004 would be inferred.

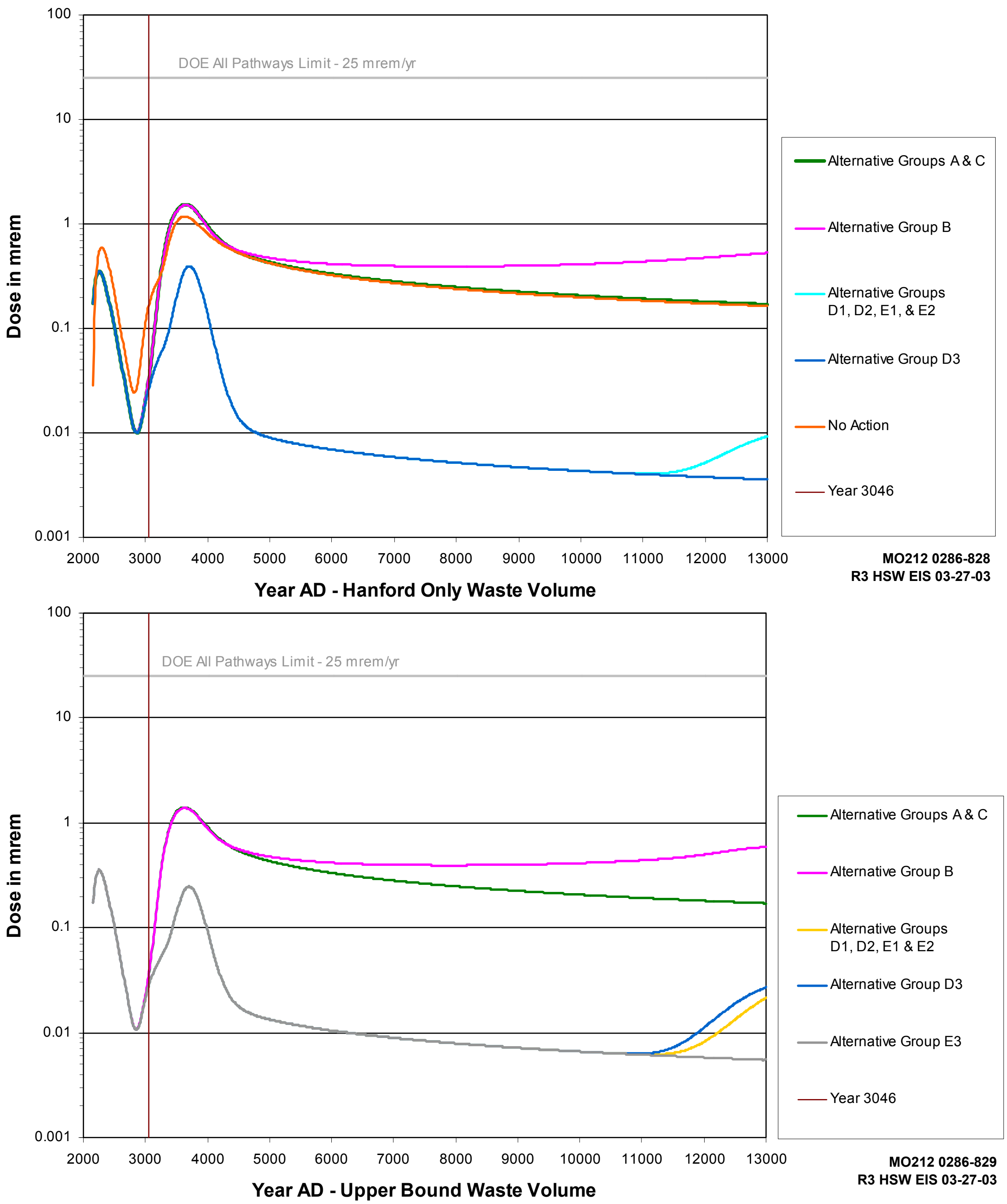


Figure 3.9. Annual Dose to a Hypothetical Resident Gardener at Various Times over 10,000 Years Using Water from a Well 1 km Downgradient from 200 West Area

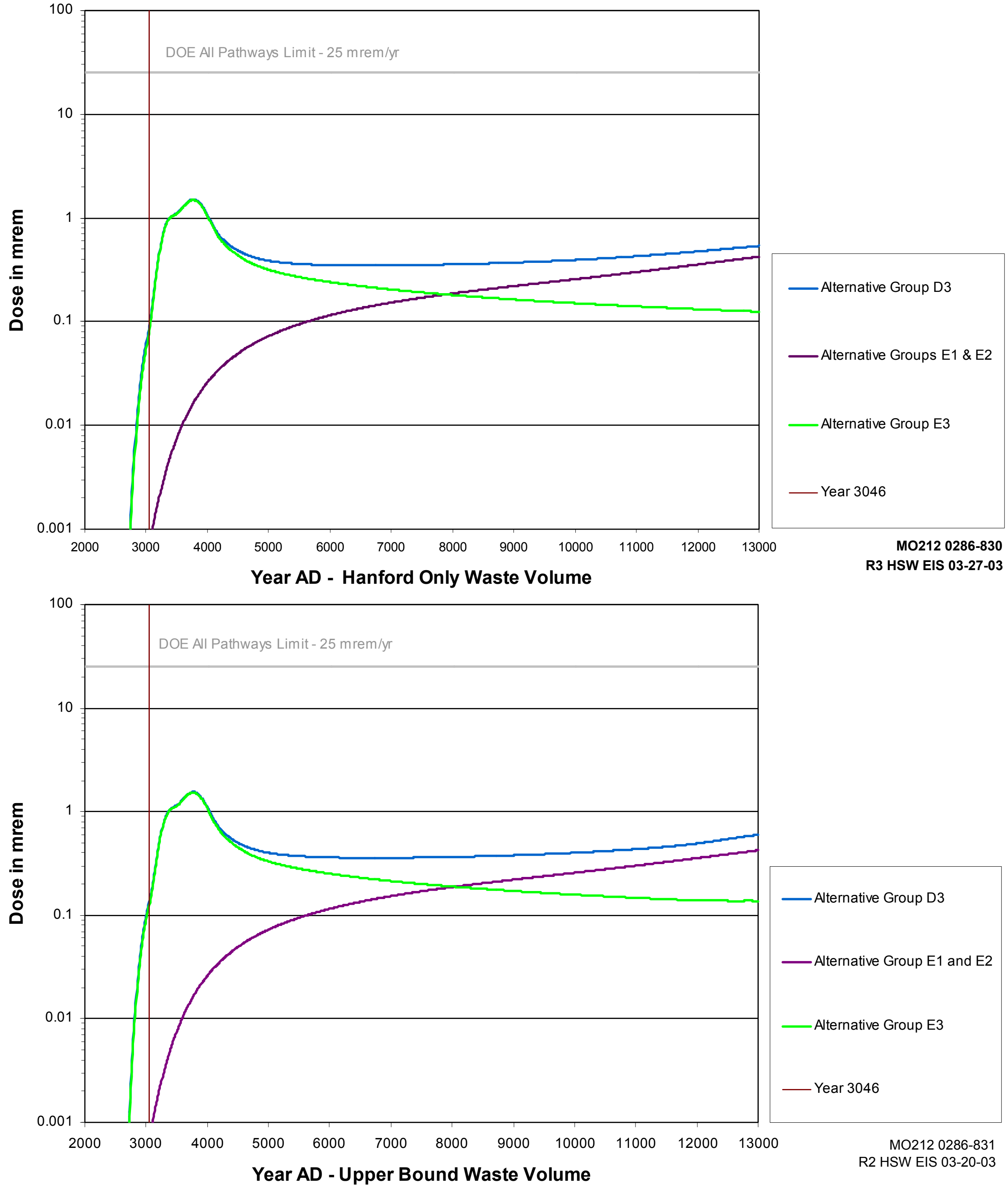
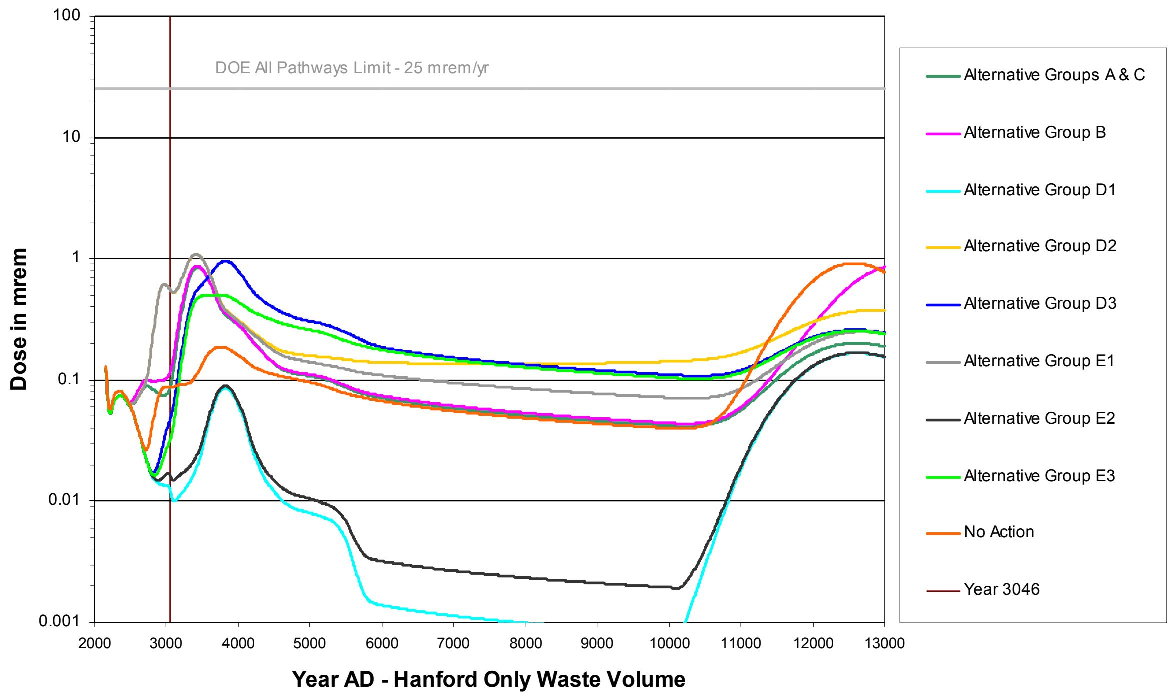


Figure 3.10. Annual Dose to a Hypothetical Resident Gardener at Various Times over 10,000 Years Using Water from a Well 1 km Downgradient from ERDF



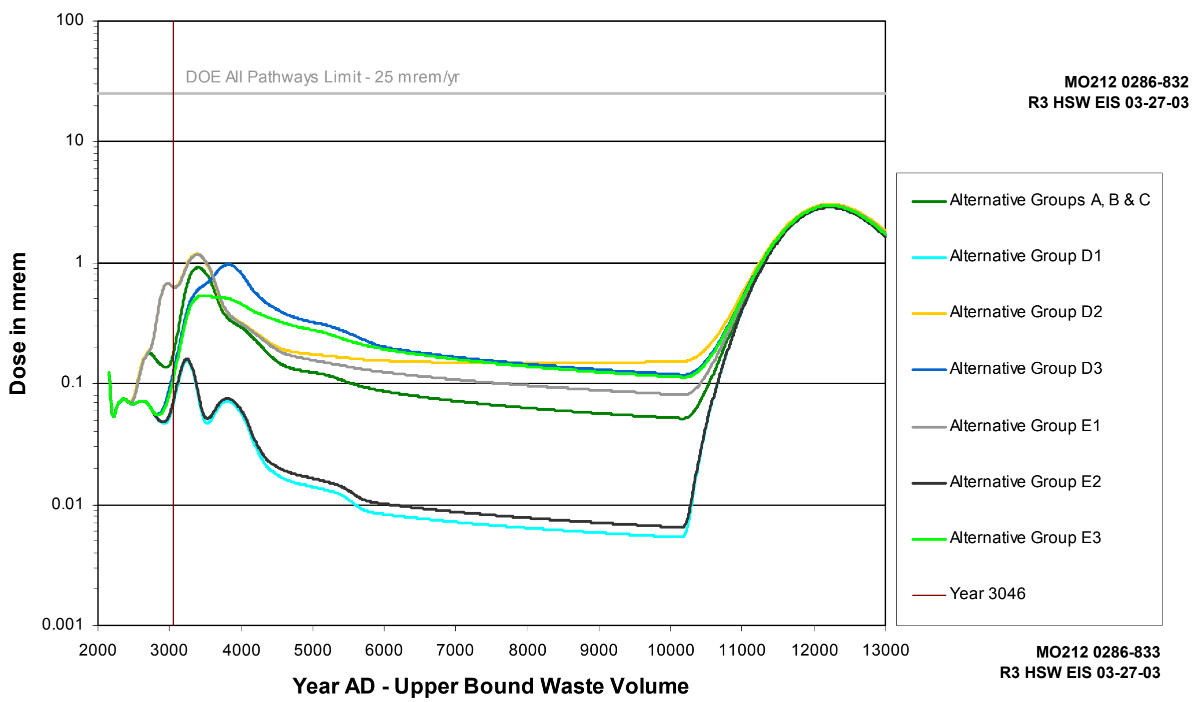


Figure 3.11. Annual Dose to a Hypothetical Resident Gardener at Various Times over 10,000 Years Using Water from a Well 1 km Downgradient Northwest from 200 East Area

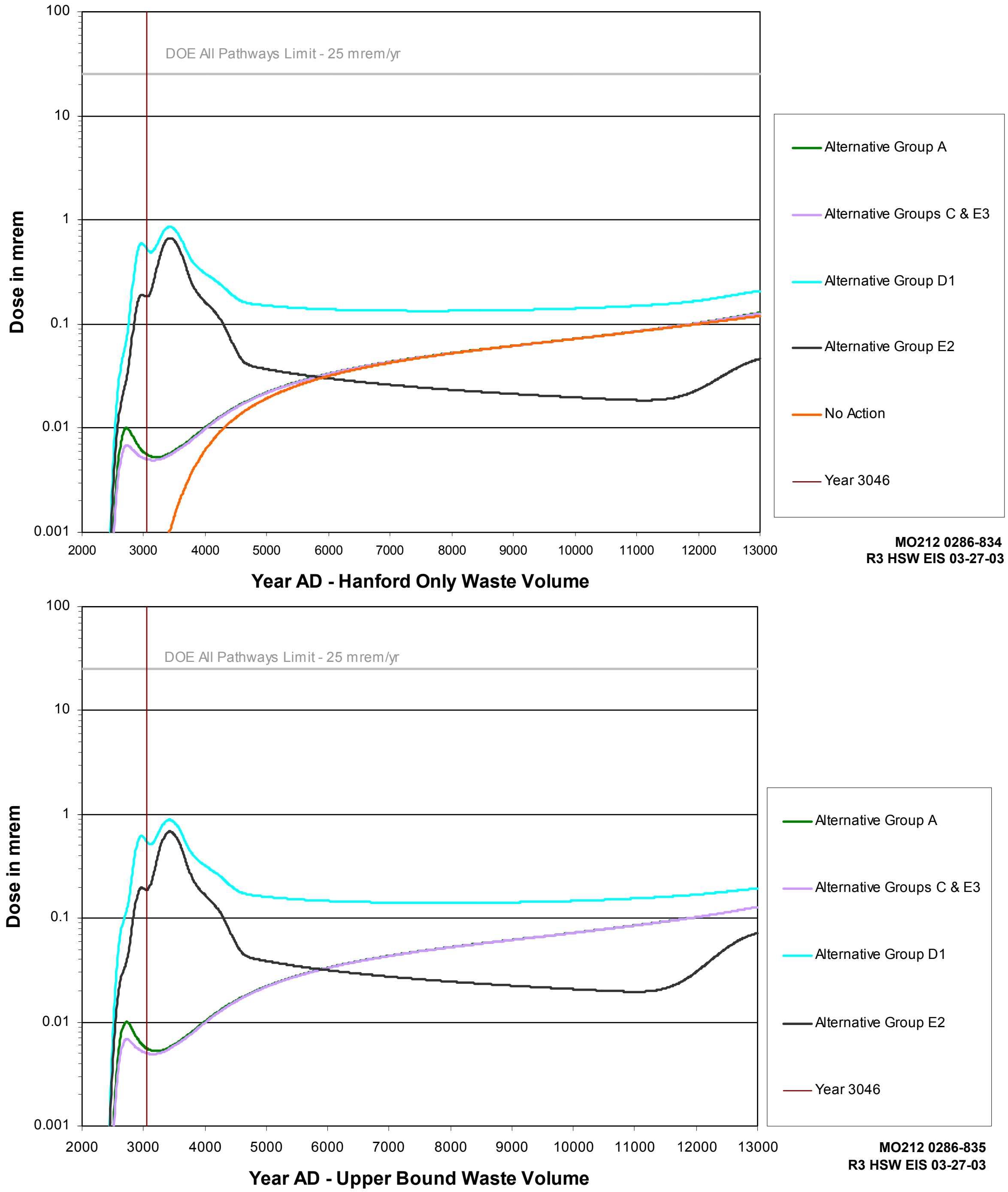
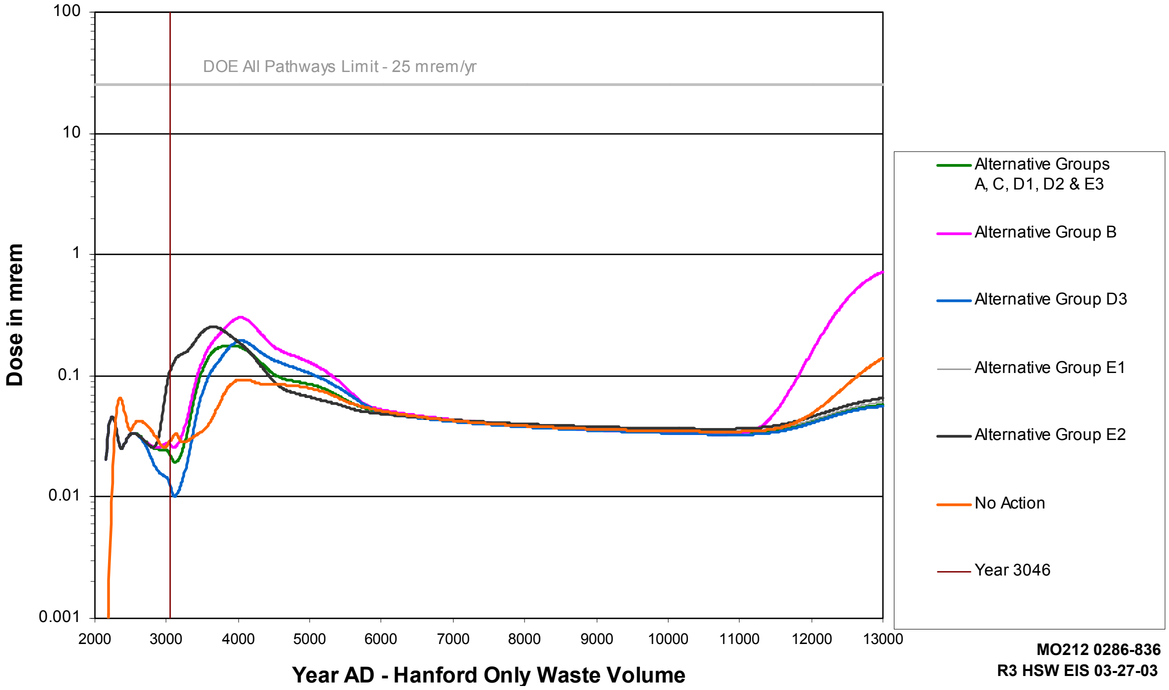


Figure 3.12. Annual Dose to a Hypothetical Resident Gardener at Various Times over 10,000 Years Using Water from a Well 1 km Downgradient Southeast of 200 East Area



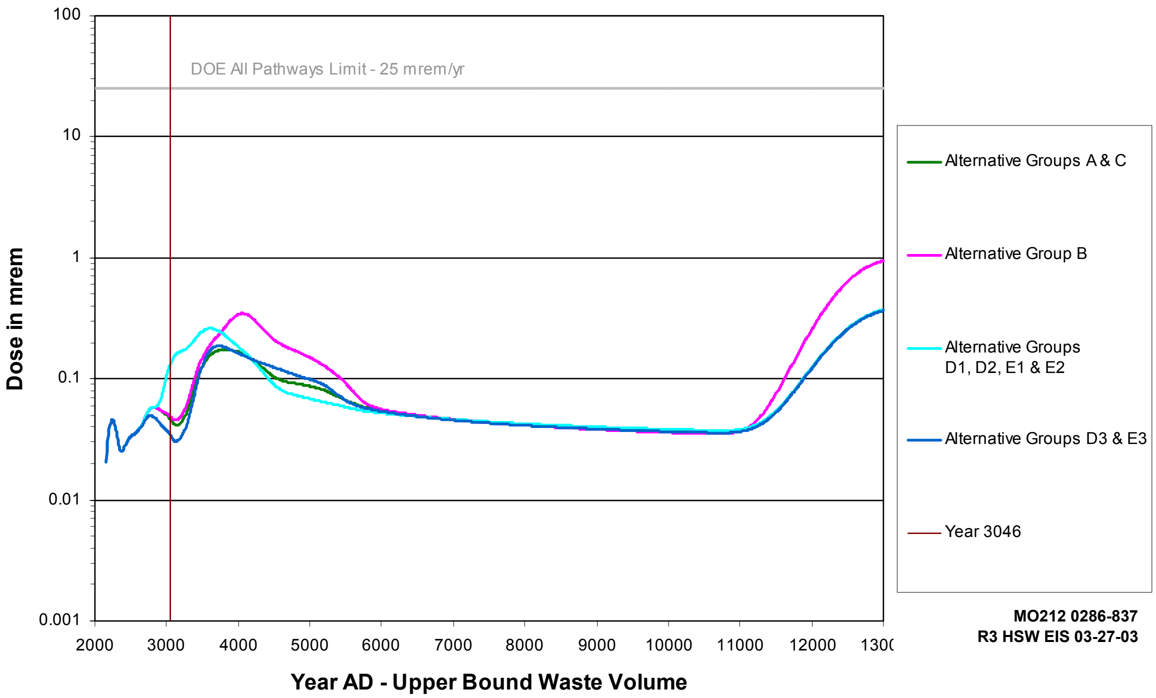


Figure 3.13. Annual Dose to a Hypothetical Resident Gardener at Various Times over 10,000 Years Using Water from a Well Adjacent to the Columbia River

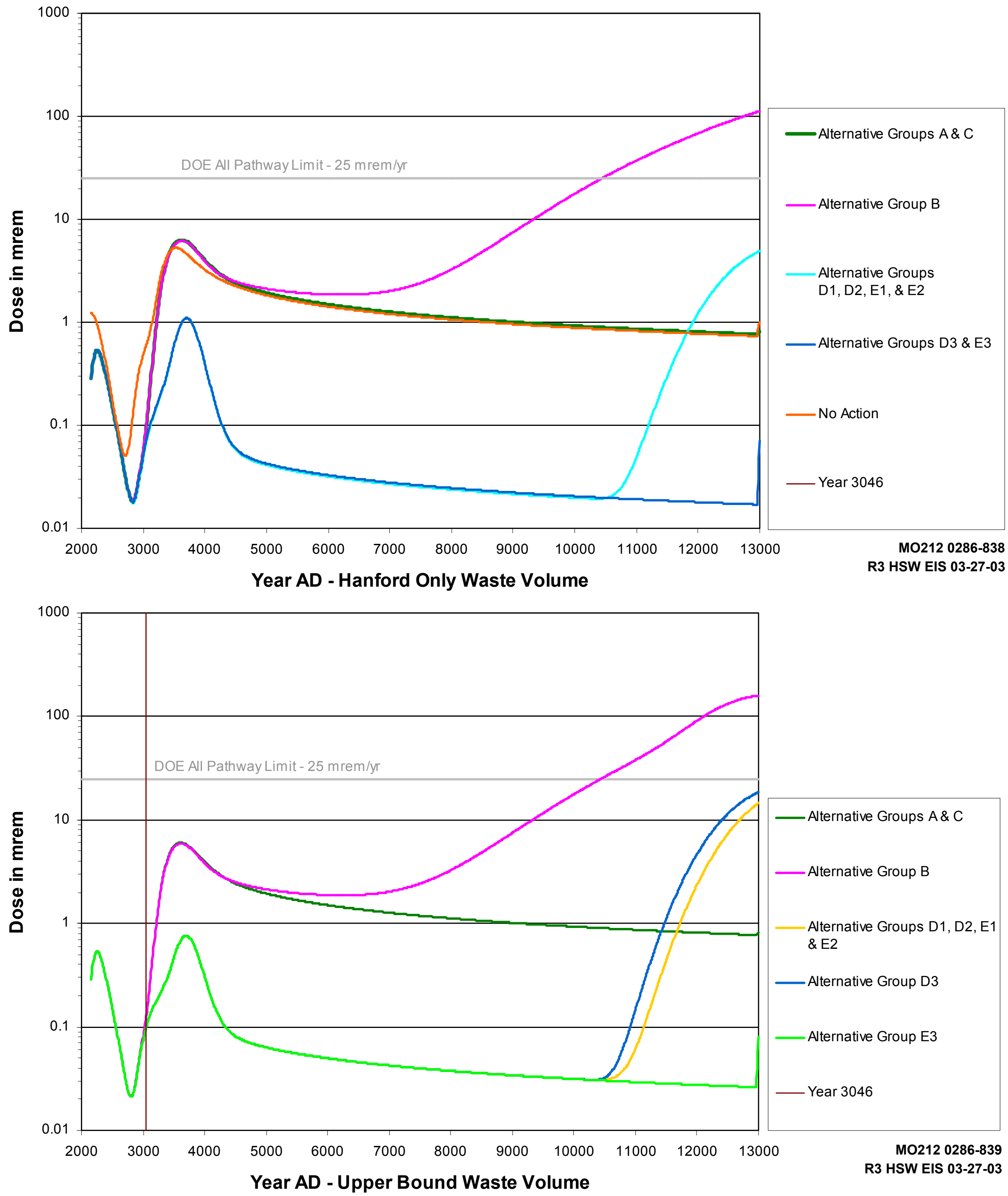


Figure 3.14. Annual Dose to a Hypothetical Resident Gardener with Sauna/Sweat Lodge at Various Times over 10,000 Years Using Water from a Well 1 km Downgradient from 200 West Area

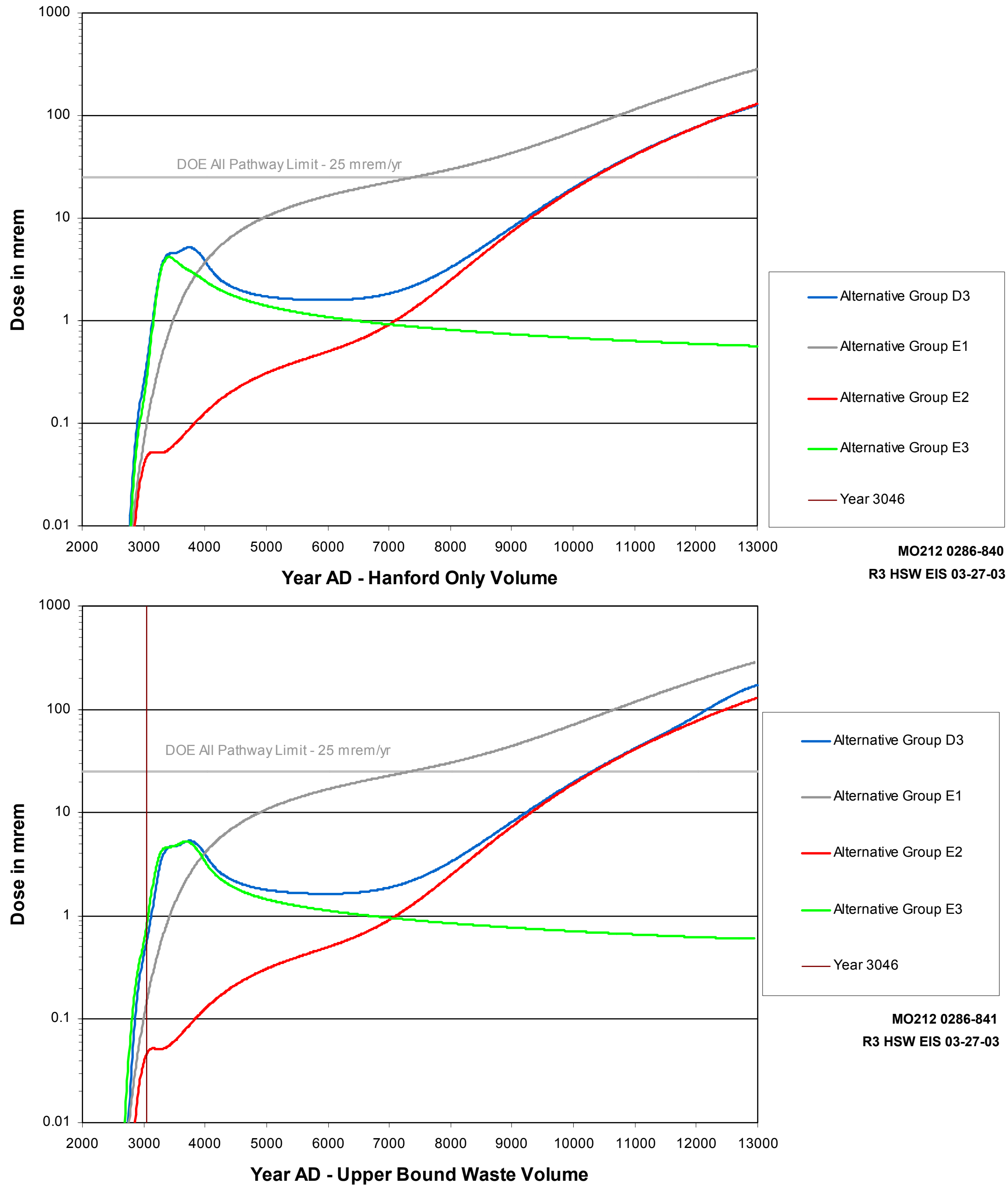


Figure 3.15. Annual Dose to a Hypothetical Resident Gardener with Sauna/Sweat Lodge at Various Times over 10,000 Years Using Water from a Well 1 km Downgradient from ERDF

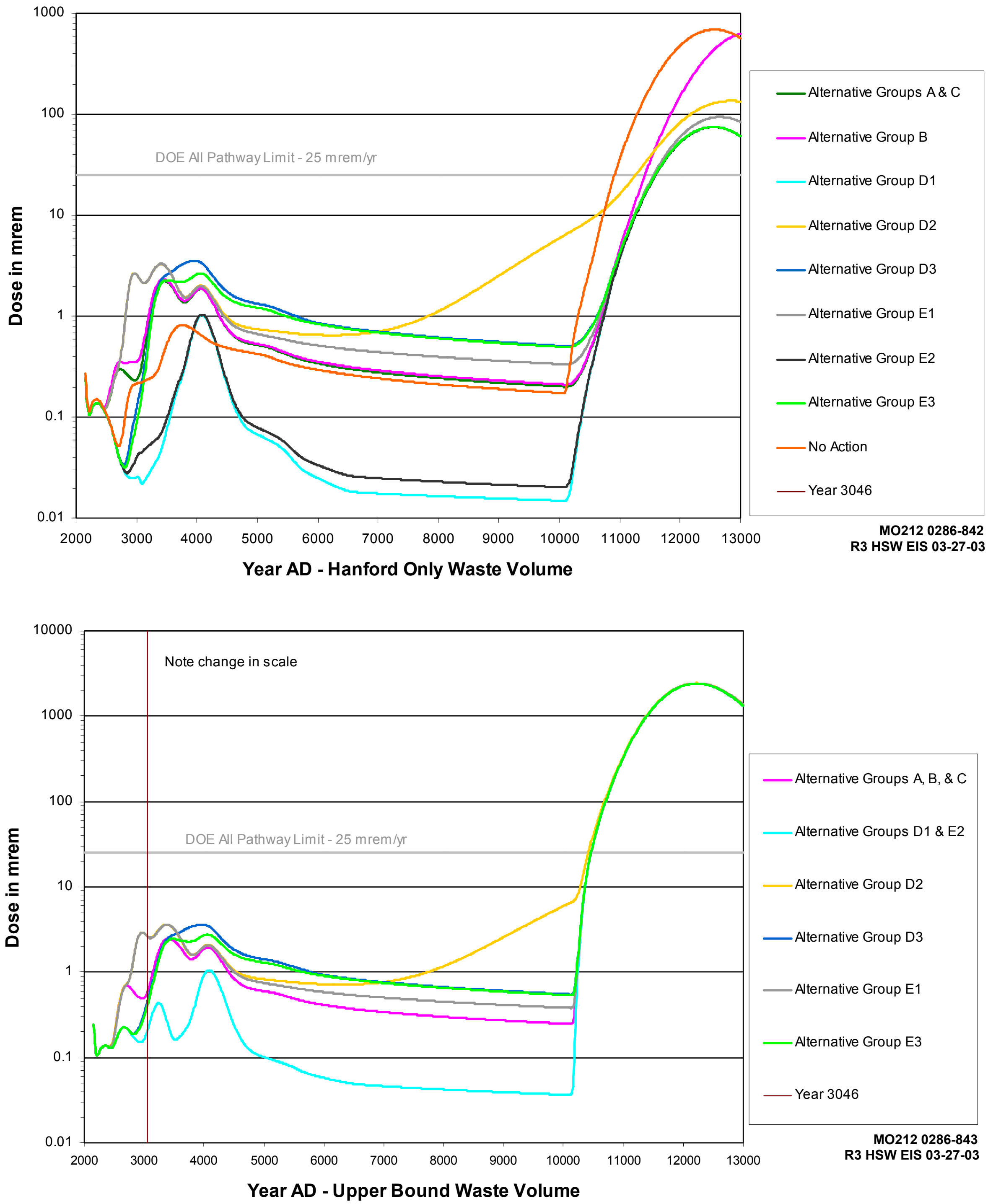


Figure 3.16. Annual Dose to a Hypothetical Resident Gardener with Sauna/Sweat Lodge at Various Times over 10,000 Years Using Water from a Well 1 km Downgradient Northwest from 200 East Area

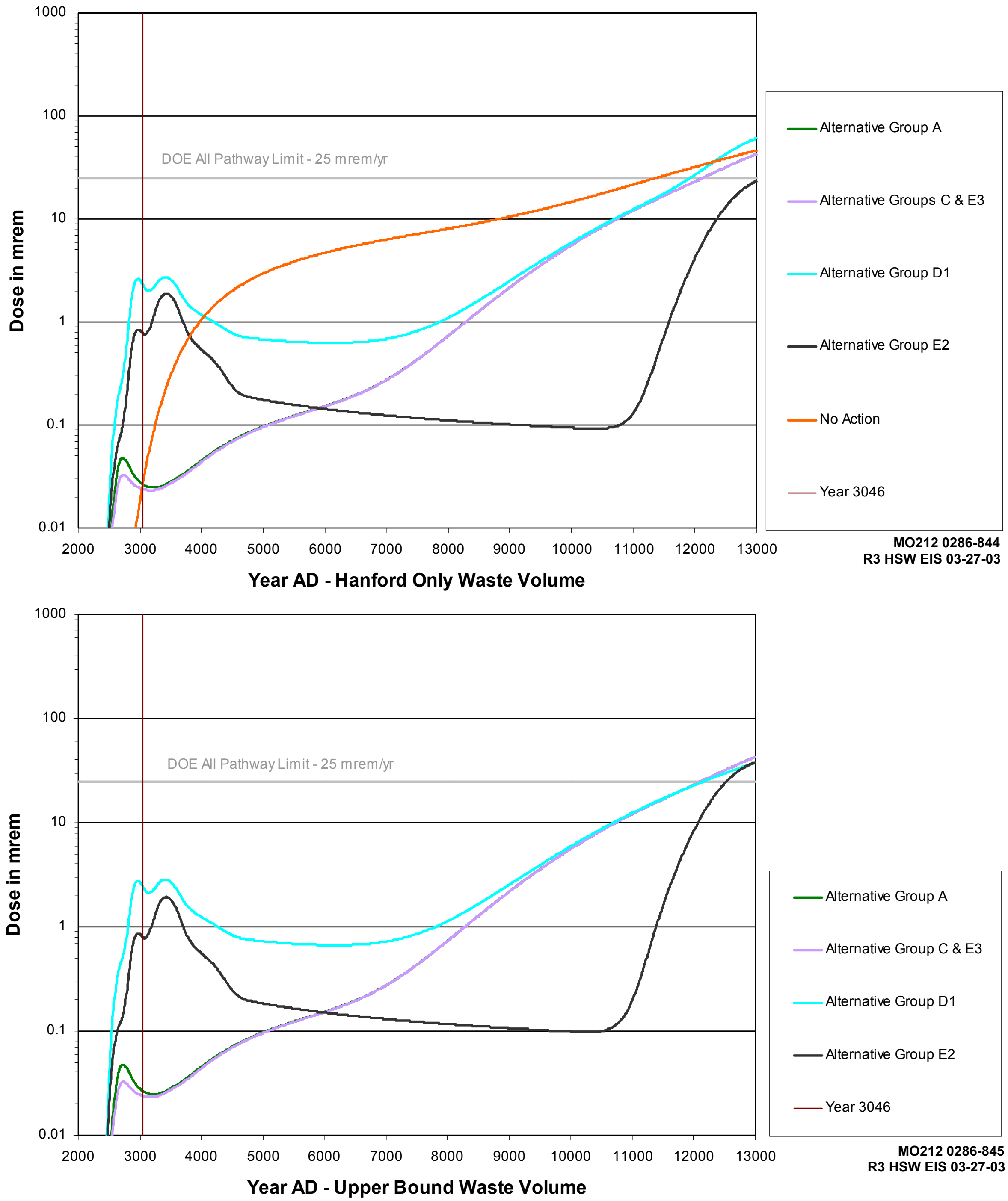


Figure 3.17. Annual Dose to a Hypothetical Resident Gardener with Sauna/Sweat Lodge at Various Times over 10,000 Years Using Water from a Well 1 km Downgradient Southeast from 200 East Area

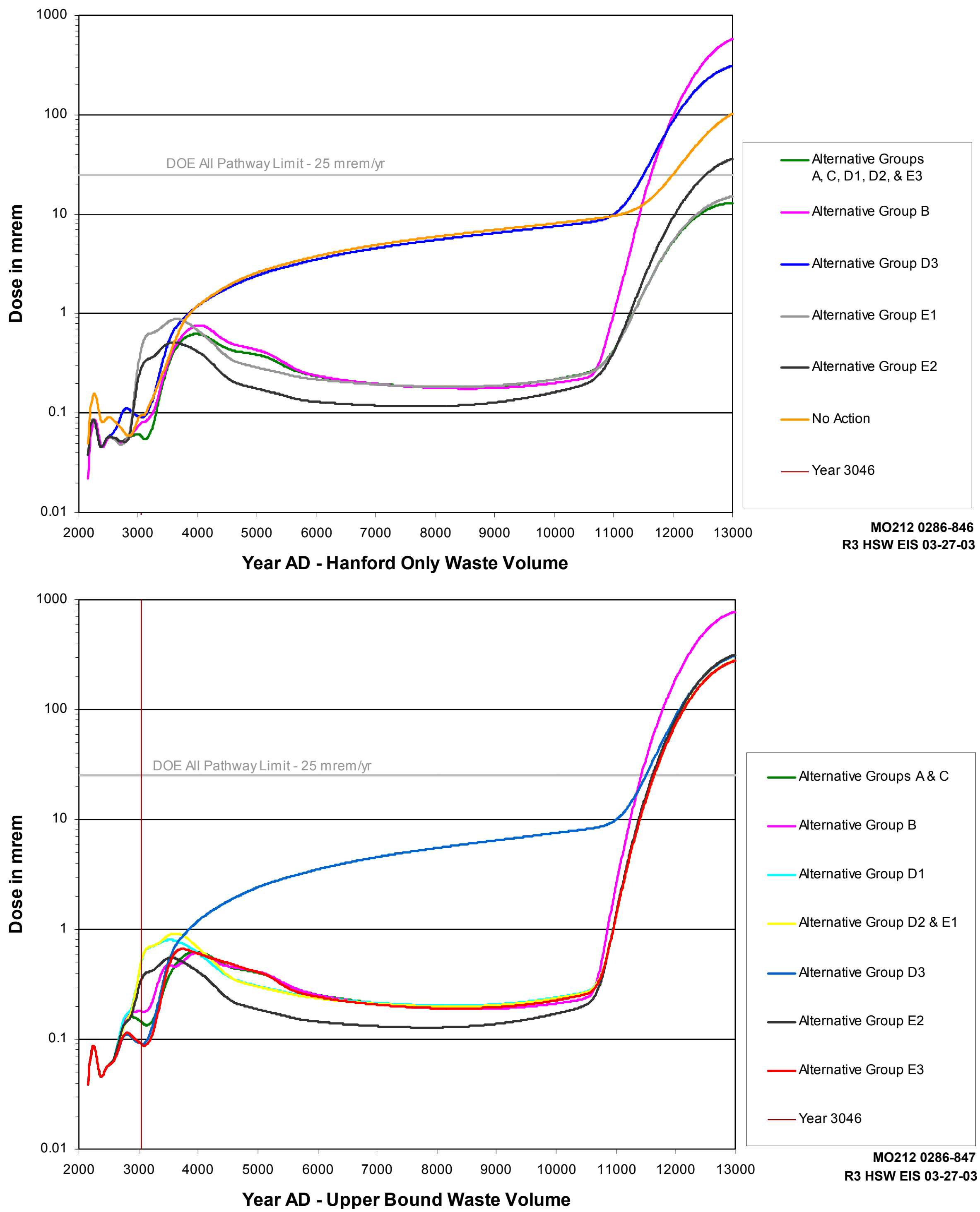


Figure 3.18. Annual Dose to a Hypothetical Resident Gardener with Sauna/Sweat Lodge at Various Times over 10,000 Years Using Water from a Well Adjacent to the Columbia River

3.4.12 Cumulative Impacts

Potential cumulative impacts associated with implementing the various alternative groups and waste volumes would be essentially the same for all alternatives (see Section 5.14). The cumulative impacts analysis focused on past, present, and reasonably foreseeable future actions. Other such current and future actions at Hanford include preparation for and disposal of tank waste and strontium and cesium capsules, CERCLA remediation projects, decontamination and decommissioning of the Hanford production reactors and canyon facilities, operation of a commercial LLW disposal site by US Ecology, and operation of the Columbia Generating Station by Energy Northwest. Cumulative impacts regarding worker health and safety, public health (for atmospheric, surface water, and groundwater pathways), land use, air quality, and ecological, cultural, and socioeconomic resources were evaluated. For most resource and potential impact areas, the combined affects from the HSW EIS proposed actions added to these activities are small.

Special emphasis was given to cumulative impacts associated with contamination of groundwater and the Columbia River. Cumulative groundwater impacts are examined in the context of existing sources of contamination in the soil, vadose zone, and groundwater. Groundwater beneath the operational areas and in plumes from the Central Plateau moving towards the Columbia River is currently contaminated with hazardous chemicals and radionuclides from past liquid and other disposal practices and unplanned releases. Radionuclides leached from wastes in the environment could eventually be transported through the vadose zone to groundwater. Although not used as a source of drinking water today nor in the foreseeable future, it was analyzed as such a scenario where and the dose to an individual who in the future might drill a well through the vadose zone to groundwater and consume two liters per day of the water.

To arrive at the cumulative impact from Hanford sources, all wastes intentionally or unintentionally disposed of on the Hanford Site since the beginning of operations and waste forecast to be disposed of through cleanup completion were taken into account. Technetium-99 and uranium isotopes were selected as representative of long-lived mobile radionuclides and were analyzed using the System Assessment Capability (SAC) (Kincaid et al. 2000) software and data (see Section 5.14 and Appendix L).

Using the SAC analysis, it was concluded that the potential dose from groundwater contamination by technetium-99 would be dominated by the existing groundwater plumes and releases from liquid waste disposal sites (e.g., cribs, ponds, ditches) over the next 2,000 years. Figure 3.19 illustrates the results of the analysis.

The SAC was also employed to evaluate the relative role in overall release of different waste types, including solid waste, past liquid discharges, past tank leaks, future tank losses, tank residuals, unplanned releases, and facilities including canyon buildings. In the simulation, the contribution to technetium-99 from solid waste releases to groundwater would amount to approximately 20 percent of the cumulative release from all Hanford sources. For uranium, releases from solid waste to groundwater are much lower. The majority of the technetium-99 and uranium releases from wastes (other than ILAW) were predicted to occur from liquid discharge sites (e.g., cribs, ponds, ditches) used in the past and from unplanned releases on the Central Plateau and from off-plateau waste sites.

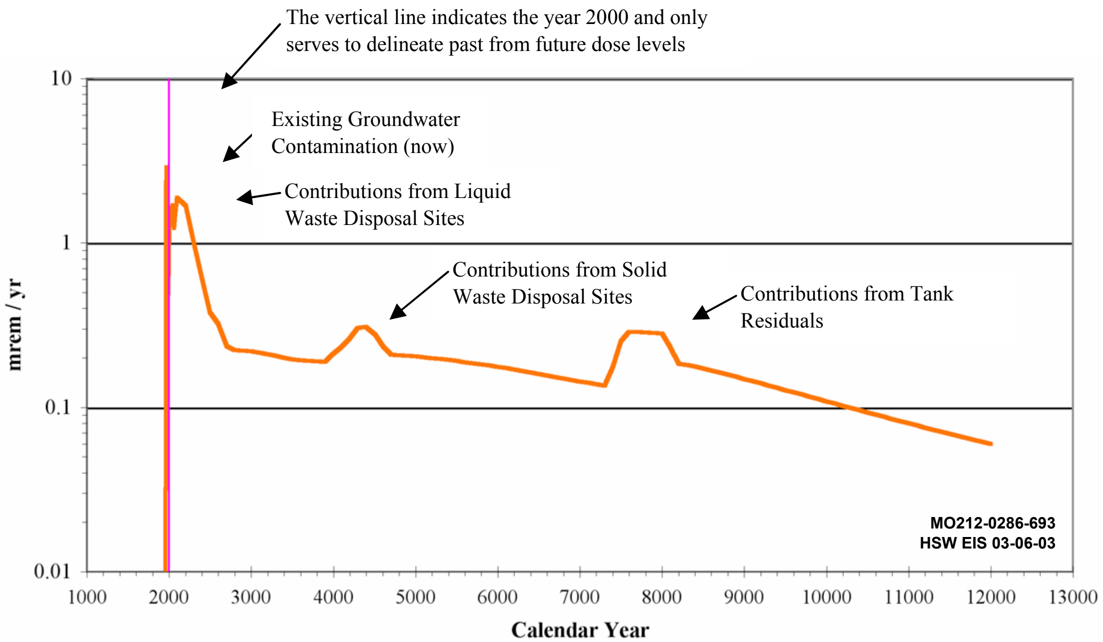


Figure 3.19. Annual Drinking Water Dose from Technetium-99 in Groundwater Southeast of the 200 East Area from All Hanford Sources Including ILAW

3.5 Areas of Uncertainty, Incomplete, or Unavailable Information

This section discusses uncertainties associated with alternatives evaluated in the HSW EIS, and takes into account areas where information is either incomplete or unavailable. Because an EIS is by nature a document prepared during the planning stages for a proposed action, information needed to evaluate environmental impacts of the activities in detail may not always be available. In some cases, there are uncertainties that cannot be resolved by collection or development of additional information, such as the uncertainties associated with projected environmental impacts at very long times in the future, or those associated with inherent variability in human and ecological systems. The approach used to account for these uncertainties would vary with the nature of the impact being evaluated and the methods used for the assessment. The individual analyses of environmental impact areas in Section 5 provide additional detail regarding uncertainties unique to each evaluation. Major areas of uncertainty associated with the proposed waste management alternatives evaluated in this HSW EIS are described in the following sections.

3.5.1 Waste Volumes

The volume of wastes that could ultimately be managed at Hanford represents one of the larger uncertainties associated with the analyses in this EIS. Many of the impact assessments depend on the waste volume that ultimately requires treatment or disposal onsite. Forecasts of future waste volumes from Hanford generators have been compiled for a number of years, and have been shown to be reasonably accurate, if somewhat conservative overall (See Appendix B). Potential waste receipts from offsite generators are associated with uncertainties due to cost, schedule, and other factors. The performance assessment process may also limit incoming waste quantities in order to ensure compliance with applicable requirements. The HSW EIS accounts for this uncertainty by evaluating a range of waste volumes as described in Section 3.3. Those waste volumes represent estimates of the minimum and maximum waste quantities reasonably expected to be received at Hanford during active waste management operations. The basis for the waste volumes is described in Appendix B.

3.5.2 Waste Inventories of Radioactive and Hazardous Materials

The quantities of radioactive and hazardous components in waste also contribute to environmental impacts, particularly those associated with air emissions and long-term performance of disposal facilities. The basis for waste inventories varies with the type of waste and its source, and may include information such as process knowledge or direct assay. In general, inventories for wastes received in recent years are expected to be associated with less uncertainty than those disposed of in the early 1970s. Wastes received in later years are more fully characterized because of improved analytical capabilities and added requirements for record keeping. Inventories of hazardous chemicals in mixed waste were not required to be determined or documented before the application of RCRA to mixed radioactive waste to DOE in 1987. Therefore uncertainty regarding the content of hazardous materials in wastes disposed of before that time is generally higher than for radionuclides. The HSW EIS analyses generally account for those uncertainties by making conservative assumptions regarding waste inventories based on process knowledge, assays of previously received waste, or other available information. For example, the inventory of iodine-129 in past and potential future waste receipts has been estimated using the total production at Hanford, sampling of releases to the atmosphere from fuel processing facilities, and analytical information on tank waste and other waste streams as described in Appendix L.

Chemical inventories in pre-1988 waste have not been specifically estimated for analysis in the HSW EIS because data are generally lacking in the absence of sampling and characterization of hazardous chemicals in the previously disposed waste. However, post-1988 solid waste has been characterized and typically contains only small quantities of hazardous materials (see Appendix F). Most hazardous materials used in large quantities at Hanford were organic liquids or solutions containing inorganic compounds and metals such as cadmium. Some of those contaminants have been detected in groundwater as a result of past liquid waste disposal practices. Other regulated hazardous materials, such as lead, were typically in a solid non-dispersible form and are not highly mobile in groundwater. Sampling of groundwater and soil in the vicinity of solid waste disposal facilities has not provided evidence that these facilities contributed to existing groundwater contamination (Hartman et al. 2002). A previous evaluation of waste disposal sites confirmed that groundwater contamination by hazardous chemicals was primarily a result of past liquid discharges rather than solid waste disposals (DOE 1996).

Disposal of untreated liquids to ground was discontinued in 1995, and there is an ongoing program to characterize and remediate soil and groundwater contaminated by past discharges (Hartman et al. 2002). For example, some LLBGs in the 200 West Area were sampled recently as part of an ongoing CERCLA investigation to characterize and remediate past carbon tetrachloride discharges in the vicinity of the Plutonium Finishing Plant. Sampling detected the presence of carbon tetrachloride vapor in soil at the bottom of some disposal trenches about 4.6–6.1 m (15–20 ft) below ground. The source of the vapor could not be determined from the initial sampling, but was estimated to be either waste in the disposal trench, or lateral migration of vapor from former liquid discharge sites in the vicinity. The sampling risers were capped except during sample collection, and measured vapor concentrations in air at the ground surface were well within workplace exposure standards. Because of those results, and because the vapor is approximately five times the density of air, there was no evidence that potentially hazardous releases to the atmosphere had occurred. However, additional soil sampling has been planned to investigate the source of the vapor and to determine whether there may have been liquid carbon tetrachloride releases to soil beneath the trenches. Depending on those future findings, remedial actions would be carried out during retrieval of stored transuranic waste from the trenches or at closure of the LLBGs.

MLLW currently in storage, and MLLW that may be received in the future, would be treated to applicable standards for land disposal, and is not expected to present a hazard over the long term because the hazardous components would either be destroyed or stabilized by the treatment. Inventories of hazardous materials in stored and forecast waste are either very small, or consist of metals with low mobility (see Appendix F). Disposal facilities containing pre-1988 waste would be evaluated using RCRA past practice or CERCLA processes to determine whether remedial action would be required before the facilities are closed. Therefore the long-term risks from these wastes would either be determined to be minimal, or the waste would be remediated by removal or treatment to reduce its potential hazard.

Hanford's high-level waste tanks also contain a complex mixture of radionuclides and chemicals, which adds a degree of uncertainty to the analyses associated with ILAW disposal. Historical data, such as chemical purchase invoices, records of waste transfers, and process knowledge, have been used to estimate total inventories of materials in the tank waste collectively. There is an ongoing waste characterization program to better determine the contents of each individual tank through sampling and analysis to support safety evaluations and remedial action decisions. Collection of that information continues, but is not yet complete. The lack of detailed characterization information on a tank-by-tank basis adds a level of uncertainty to certain aspects of the tank waste treatment project. However, that information is less critical to determining the long-term impacts of disposal, which are based on the total ILAW inventory. Treatment processes that would affect the composition and form of the final product are still under investigation as well. Some of the processes under consideration have not been applied to this type of waste, or have not been used on the scale necessary for the project, and some uncertainty will remain in these areas until the processes are more fully developed and tested. To account for these uncertainties, the assumptions in this EIS are based on waste characterization and processing data that are intended to provide a conservative, or bounding, analysis of impacts for the alternatives under consideration.

3.5.3 Fate and Transport of Radioactive and Hazardous Materials

Estimating transport of hazardous materials or radionuclides through various environmental pathways to human or ecological receptors is a complex process, often requiring extensive input data. In order to predict the potential for future impacts, it is typically necessary to use computer models to simulate their transport and receptor exposure rates. Computer modeling may also be used to estimate the impacts from past releases where the quantity of released material is too small to measure in the field, or where contaminants arrive at the receptor location at very long times after the release occurs. The amount of data required for a particular simulation depends on the transport medium and exposure pathways of interest. The information needed to model transport through the environment may be relatively straightforward, such as measurements of wind direction and velocity, or highly complex, such as groundwater flow rates and directions. Likewise, exposure of receptors can depend on the behaviors of individuals or populations, such as food consumption rates.

With respect to long-term performance of disposal facilities, the transport of contaminants depends on performance of the waste form, factors affecting infiltration of water through the waste, and flow rates of groundwater, all of which are subject to substantial uncertainty over the long term. Contaminant release rates depend on treatment processes and the resulting physical and chemical characteristics of the waste form. For example, future decisions regarding the tank waste treatment process may affect the composition and long-term performance of the ILAW product, and some uncertainty will remain in these areas until the processes are more fully developed and tested. Performance of different ILAW waste forms is discussed briefly in Appendix G. Performance of the engineered disposal system, such as the use of greater confinement (HICs or trench grouting), trench liners, or infiltration barriers over the disposal facility is also difficult to predict over the very long time periods used for the analyses in performance assessments and in this EIS. Other factors such as the geochemical environment, climate, and natural recharge rates in the future add to the uncertainty in predicting contaminant transport. In general, interactions among waste components that could change the geochemistry in the immediate vicinity of the disposal facility, such as the possible presence of organic chemicals in some previously disposed waste, are not expected to affect contaminant mobility over the long term. Such interactions would require relatively high concentrations of contaminants or large volumes of liquids to substantially influence contaminant mobility over the entire transport path. The solid wastes considered in this EIS do not typically contain large enough quantities of liquid organic chemicals or other potentially mobilizing agents to affect transport by this mechanism (See Appendix G).

After contaminants reach the accessible environment, potential impacts are controlled by the mechanisms that result in exposure to individuals or populations. Recent studies of long-term transport of contaminants in groundwater indicated that, for estimates of human health effects, variability with regard to individual behavior and exposure affects uncertainty in the result more than variability in inventory, release, or environmental transport of the contaminant (Bryce et al. 2002).

To account for these uncertainties, the assumptions in this EIS are based on waste characterization and processing data that are intended to provide a conservative, or bounding, analysis of impacts for the alternatives under consideration. Engineered systems are assumed to be effective for a reasonable but limited time compared to the period of analysis. Uncertainties associated with exposure parameters are typically addressed by using conservative assumptions in the model simulations, that is, assumptions that tend to maximize the exposure of individuals or populations to contaminants. An example is the use of unfavorable atmospheric dispersion conditions to maximize the downwind concentrations of hazardous materials in accident simulations, as in the analyses reported in Section 5.11. In other cases, each parameter input to a simulation can be assigned a distribution of values, and multiple simulations can be run using randomly selected values for each parameter to obtain a distribution of outcomes associated with various probabilities. That approach was used to some extent for the cumulative groundwater impacts analysis described in Section 5.14 and Appendix L.

3.5.4 Human and Ecological Risk Associated with Exposure to Radioactive and Hazardous Materials

Human and ecological risk estimates are subject to many of the same uncertainties associated with fate and transport as described in the previous section. An added uncertainty is the inherent variability in biological and ecological systems, such as the genetic variation in populations that may predispose a particular individual to adverse health effects following exposure to a potentially hazardous material. Data on relative risks from hazardous material exposure are typically more difficult to obtain because of the ethical constraints on experimentation with human subjects. Extrapolating risk from animal studies to humans, or extrapolations of ecological impacts between different animal species, introduces additional uncertainty into the consequence estimates. Estimates of cancer risk in very long-term analyses, such as those for groundwater quality, are likely to overestimate the risks, because they do not account for the possible development of medical treatments that could prevent those consequences in the future.

As with the environmental transport calculations the approach used in the HSW EIS was to assign conservative values to most of the input parameters used in modeling risk from hazardous material exposures. For example, the estimates of potential cancer risk from exposure to radiation at very low doses, such as those from most environmental exposures, are based on data obtained at higher exposure rates and by different exposure pathways. The effect is assumed to be proportional to the dose received, although in the case of radiation, there is no experimental or epidemiological evidence that such effects occur at very low doses. The estimates of cancer incidence or fatality from very low radiation doses are therefore conservatively high, and encompass a range of possible risks that includes zero risk.

3.5.5 Technical Maturity of Alternative Treatment Processes

Treatment technologies for most types of MLLW are specified by regulation. Where more than one technology might apply to a particular waste stream, a reference treatment technology was assumed for purposes of analysis. The consequences of waste treatment were typically estimated using conservative but realistic assumptions appropriate for the reference technology. For example, thermal treatment processes would be expected to result in greater emissions to the atmosphere than non-thermal technologies such as macroencapsulation. One uncertainty associated with MLLW treatment is the currently limited availability of thermal treatment processes for waste containing hazardous organic components. For purposes of analysis, this EIS assumed such treatment would be available at offsite commercial facilities within a reasonable time. However, an additional alternative was evaluated to consider the use of non-thermal options for those wastes in the event such treatment is not available.

With respect to ILAW, the reference treatment was assumed to be vitrification or another technology that produces a waste form having equivalent long-term performance. Other treatment technologies are currently under consideration for the low activity waste stream; however, those technologies are not sufficiently mature for detailed evaluation at this time. The uncertainties associated with long-term performance of ILAW are addressed in this EIS by considering a range of performance characteristics for this waste stream (see Appendix G).

3.5.6 Timing of Activities Evaluated in the Alternative Groups

Under all HSW EIS alternative groups, there are uncertainties related to the timing of their implementation. Timing uncertainties include:

- the technical maturity of waste treatment technologies and the amount of development necessary before design and construction of facilities could proceed

- the possibility that regulatory requirements could change, which could introduce delays by affecting the design and cost of selected alternatives

- the time required to obtain necessary permits and approvals for various treatment, storage and disposal actions

- the timely appropriation of funds by Congress to enable DOE to implement decisions resulting from this EIS

- the effect of proposals for accelerated cleanup at Hanford (DOE-RL 2002) and at other DOE facilities, which could potentially influence the timing and quantities of waste receipts.

In general, these uncertainties are addressed in this EIS by adopting conservative assumptions in analyses (that is, assumptions that would tend to maximize the estimated environmental impacts). The timing of activities evaluated in the EIS may differ from assumptions used in the analyses; however, the nature and extent of those actions are expected to be similar whenever they may occur.

3.6 Costs of Alternatives

Consolidated cost estimates were prepared for the continued operation of existing facilities, the modification of existing facilities, construction of new facilities, and operation of the new or modified facilities (FH 2003; Aromi and Freeburg 2002). The costs were calculated using a constant 2002 dollars. Some operations, such as capping the LLBGs and treatment of leachate from mixed waste trenches, would continue beyond 2046. These costs have been included as a separate category. The cost of each major facility for each alternative group is shown in Table 3.21. The increased costs for the operation of the LLBGs with the increased volume of waste can be seen. Because the additional MLLW in the Upper Bound waste volume do not need treatment, the costs for treatment facilities do not change. In the No Action Alternative Group, the increased needs for storage of MLLW and the limited volume of waste disposed of are reflected in the relative costs of the CWC and the MLLW trenches. The increased costs for the baseline operation of the T Plant Complex for the No Action Alternative Group compared with Alternative Groups A, B, and C result from the continuing need to store the K Basin sludge in the No Action Alternative. The combination of commercial MLLW treatment and modification of the T Plant Complex in Alternative Group A is less expensive than construction of a new facility, with DOE doing the majority of the treatment onsite in Alternative Group B. The consolidation of disposal facilities should lead to lower disposal costs – most easily noted in the total alternative group costs between Alternative Groups D and E and Alternative Group A.

Table 3.21 (sheet 1). Consolidated Cost Estimates for Alternative Groups A, B, and C (Construction and Operation Cost)

Cost Category	Cost of Alternatives (Millions of Dollars)								
	Group A			Group B			Group C		
	Waste Volume			Waste Volume			Waste Volume		
	Hanford Only	Lower Bound	Upper Bound	Hanford Only	Lower Bound	Upper Bound	Hanford Only	Lower Bound	Upper Bound
LLBG	267	339	484	268	340	485	267	339	484
CWC	566	566	566	566	566	566	566	566	566
WRAP	710	710	710	710	710	710	710	710	710
T Plant	376	376	376	376	376	376	376	376	376
Commercial MLLW Treatment	229	229	229	17	17	17	229	229	229
New Treatment Capacity	457	457	457	830	830	830	457	457	457
MLLW and Melter Disposal	275	275	424	268	268	429	275	275	424
ILAW Disposal	680	680	680	680	680	680	506	506	506
Post 2046 Costs	103	103	116	110	110	125	103	103	116
Total Operations	3663	3735	4042	3825	3897	4218	3489	3561	3868
Post-Operational Monitoring	75	75	75	75	75	75	75	75	75

Table 3.21 (sheet 2). Consolidated Cost Estimates for Alternative Groups D, E, and No Action

Cost Category	Cost of Alternatives (Millions of Dollars)							
	Groups D1, D2, and D3			Groups E1, E2, and E3			No Action[b]	
	Waste Volume			Waste Volume			Waste Volume	
	Hanford Only	Lower Bound	Upper Bound	Hanford Only	Lower Bound	Upper Bound	Hanford Only	Lower Bound
LLBG	(a)	(a)	(a)	(a)	(a)	(a)	268	345
CWC	566	566	566	566	566	566	1090	1090
WRAP	710	710	710	710	710	710	710	710
T Plant	376	376	376	376	376	376	511	511
Commercial MLLW Treatment	229	229	229	229	229	229	17	17
New Treatment Capacity	457	457	457	457	457	457	0	0
MLLW and Melter Disposal	755	777	1076	486	511	829	152	152
ILAW Disposal	(a)	(a)	(a)	506	506	506	706	706
Post 2046 Costs	103	103	116	103	103	116	(b)	(b)
Total Operations	3196	3218	3530	3433	3458	3789	3454	3531
Post-operational Monitoring[c]	75	75	75	75	75	75	75	75

(a) Combined disposal facility – costs included in MLLW and Melter Disposal.
(b) Does not account for costs for storage, treatment, or eventual disposal of waste remaining in storage after 2046.
(c) Estimated minimum cost of $500,000 per year for a 100-year institutional control period (DOE 2002b). Maximum cost estimated at $750,000 per year depending on number of wells and monitoring requirements.

3.7 DOE Preferred Alternative

Based on the results of the environmental consequences analyses as presented in Sections 3.4 and 5, cost, and other considerations, DOE has identified a preferred alternative for the HSW EIS. The preferred alternative consists of those actions identified in Alternative Group D for waste quantities up to the Upper Bound waste volumes, in addition to the use of modular facilities (from Alternative Group B) for the processing and certification of TRU waste, as follows:

Storage: The Central Waste Complex will continue as the primary storage facility for LLW, MLLW, and TRU waste. The storage of retrievably-stored TRU waste in the Low Level Burial Grounds would continue until retrieval operations are complete.

Treatment: LLW and MLLW would be treated using a combination of existing capabilities and processes, offsite commercial capabilities, and a modified T Plant. TRU waste would be processed and certified using a combination of the Waste Receiving and Processing Facility, a modified T Plant, and the modular facilities.

Disposal: LLW, MLLW, ILAW, and melters would be disposed of in a new modular facility. This new disposal facility would include a RCRA-compliant liner and a leachate collection system and upon closure would be capped with the modified RCRA Subtitle C cover. Existing Low Level Burial Grounds would be similarly capped. These existing Low Level Burial Grounds would continue to be used pending operation of the new disposal facility.

In general, alternatives outlined in Alternative Groups D and E would be the most environmentally preferable, operationally efficient, and marginally cost-effective. The differences in impacts between Alternative Groups D and E and their respective subgroups would be minor. However, Alternative Group D appears to offer a combination of low environmental impacts and low cost. Waste disposal operations would be combined in a single location that could provide a more efficient regulatory pathway to construction and operation.

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